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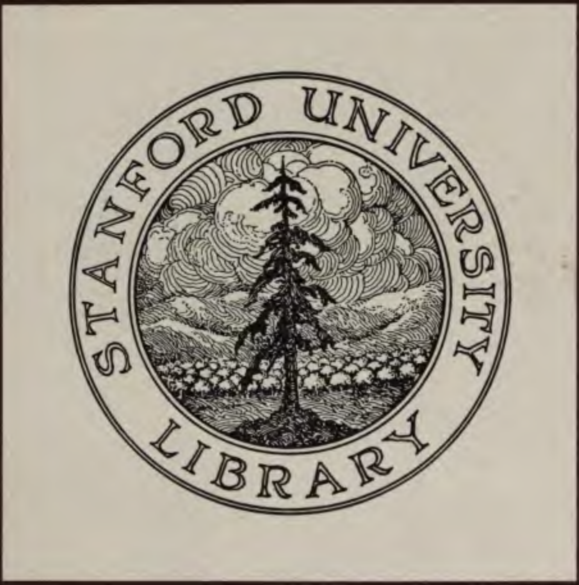

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EDITED BY R. H. JACKSON.

Published Quarterly by the Institute.

The following leading articles will appear in succeeding numbers:

COAST SIGNAL SERVICE,
F. B. Anderson, Lieutenant New York Naval Reserves, Member of Signal Board in Spanish War.

LESSONS OF THE SPANISH-AMERICAN WAR,
Captain B. H. McCalla, U. S. N.

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CABLE CUTTING OPERATIONS DURING THE SPANISH WAR,
Captain G. F. Goodrich, U. S. N.

THE NICARAGUA CANAL,
Captain C. H. Stockton, U. S. N.

The Board of Control, having decided last year that officers contributing valuable articles should receive appropriate compensation, has proved the wisdom of its policy by the increased sale of the Proceedings.

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On the subject of membership the Constitution reads as follows:

ARTICLE VII.

Sec. 1. The Institute shall consist of regular, life, honorary and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fee to the Secretary and Treasurer, or to the Corresponding Secretary of a Branch. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

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Sec. 5. Associate members shall be elected from officers of the Army, Revenue Marine, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: " Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control, and, if their report be favorable, the Secretary and Treasurer shall make known the result at the next meeting of the Institute, and a vote shall then be taken, a majority of votes cast by members present electing.

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Nos. 6, 7, 10, 13, 14, 15, 17, 34, 54 and 60.

Vol. XXV., No. 3. Sept., 1899. Whole No. 91.

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THE PROCEEDINGS

OF THE

UNITED STATES NAVAL INSTITUTE.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

WATCH, QUARTER AND STATION BILL, "AN AID TO EXECUTIVE AND DIVISION OFFICERS."

By Lieutenant Chas. A. Gove, U. S. Navy.

INTRODUCTION.

The Board of Control, believing that a necessity existed for a new Watch, Quarter and Station Bill, has made an effort to bring up the matter for discussion in the Service, with the expectation of getting a uniform, simple, but elastic system adopted to meet the present conditions and various types of ships. To this end it requested an article from Commander Schroeder. This article appeared in the last number of the Institute and the discussions upon it appear in the present number. At the same time the Institute published in book form a scheme compiled by Lieut. Gove, which was more or less familiar to the service. In the following article Lieut. Gove explains the plan in general terms, and illustrates by inserting examples. The principal points upon which criticism and discussion are invited are in Part I, the Station Bills, and a discussion upon these is especially desired.

Very respectfully,

R. H. Jackson.

Sec. and Treas.

The book is divided for convenience into three parts.

Part I.—Contains a description of the organization, the "Watch, Quarter and Station Bills."

The stations for "Fire Quarters," "General Quarters," "Collision Quarters," "Getting Underway," "Anchoring," "Mooring and Unmooring"; also, the Battle, Boat, Battalion, and Messing Bills. Stations for Water Tight Door and Hatch Tenders.

The Berthing Bill cannot be made general, as it varies with the peculiarities of each type of ship.

Part II.—Contains forms for all routine matter.

Part III.—Memoranda.

In the Watch, Quarter, and Station Bill two additional columns are given to note any special duty, relative to the watch numbers.

To show the character of the "Blank Forms," one or more pages of each Bill of Part I are given; also a few pages of Part II and Part III.

PART I.—ORGANIZATION.

The ship's complement is divided into 7 divisions. The 1st, 2nd, 3rd, and 4th constitute the Gun Divisions. The 5th the Powder and Torpedo Division. The 6th the Engineer Force. The 7th the Marine Guard. The Surgeon's and the Paymaster's Divisions will muster and drill with the 5th.

All the Divisions, excepting the 6th, are divided into 4 sections. The 1st and 3rd Sections constitute the Starboard Watch; the 2nd and 4th the Port Watch. The 6th Division (Engineer's Force) is divided into 3 sections.

The Chief Petty Officers, Yeomen, Apothecaries, Writers 1st Class, and the 1st Sergeant of Marines are designated by a letter.

Should the number of men in each Section consist of not more than 10 (the Division being 40), Petty Officers 1st Class are designated by a number of two figures. 1st Division, 11, 12, 13, 14; 7th Division, 71, 72, 73, 74. All the others of the Section have a number of three figures. 1st Division, 111, 112, &c.; 7th Division, 711, 712, &c. This would provide numbers and letters for a crew of over 300 men.

Should the number of men in each Section consist of more than 10 men, numbers of four figures would be required; Petty

Officers 1st Class to have numbers of 3 figures. 1st Division, 111, 112, &c.; 7th Division, 711, 712, &c. All the others of the Section have a number of four figures. 1st Division, 1101, 1102, &c.; 7th Division, 7101, 7102, &c. The Chief Petty Officers are still designated by a letter, and in case of more than 26 a double letter would be necessary.

Of these numbers the first signifies the Division, the second the Section, and the 3rd or 4th (as three or four figures are used) the rate in general terms of the unit of the ship's complement. (See Watch, Quarter, and Station Bill.)

One of the three Sections of the 6th Division (Engineer's Force) will be assigned each week to the Powder Division, for Battle Drill. The Section so assigned will be the 2nd relief. The corresponding number in each Section will be assigned to the same station thus: "Man 6-in. shell whip."

FIRST SECTION.	SECOND SECTION.	THIRD SECTION.
611	621	631

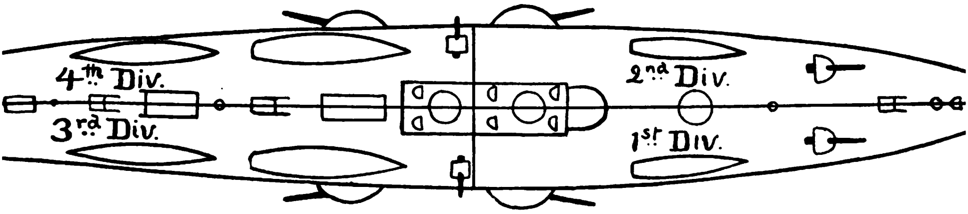
To each of the Gun Divisions there shall be assigned a "Navigator's Detail." This detail is a part of the Division in all respects, except that at Battle Drill and at "All Hands Drills" it performs the duties of the Navigator's Division. This detail consists of the Chief Quartermaster, Quartermasters, and Signal Boys. All numbers at the Gun Divisions in excess of the regular crew shall form the reserve of that Division. At Battle Drill they remain in the 5th Division, until required to fill vacancies caused by casualties. (See Battle Bill.)

The messes shall be designated as follows:

Chief Petty Officers' Mess, by letter: A, B, &c.

1st Division Mess, 11, 12, &c.; 7th Division Mess, 71, 72, &c.

The first figure signifies the Division, the second figure the number of the mess in that Division. (See Messing Bill.)



The ship is divided into four quadrants, in each of which is placed a Division, as shown by the figure above. Each Division has the care and is responsible for everything in its quadrant, from the truck to the keel. The Battery, Boats, Deck, Paint and Bright Work, Wing Passages, Funnels, Ventilators, &c. The exceptions are the Storerooms, Magazines, Torpedo, and Dynamo Rooms, which belong to the 5th Division; the spaces enclosed by the Fire and Engine Rooms, which belong to the 6th Division.

In each quadrant the work and stationing of the Division shall be divided amongst the four Sections of that Division. This may vary somewhat in different types of ships, but each Division must be kept in its own quadrant as much as possible.

In order to separate the Senior Officers in battle, the following arrangement is made:

The 1st Watch Officer has charge of the 5th Division.
“ 2nd “ “ “ “ “ 4th “
“ 3rd “ “ “ “ “ 3rd “
“ 4th “ “ “ “ “ 2nd “
“ 5th “ “ “ “ “ 1st “

The Officers of the Gun and Powder Divisions will station their men for all drills and exercises; then submit their Bills to the Executive Officer. In consultation with them, he will make out the Bills for the ship, tending to produce the greatest efficiency.

The Officers of the Divisions are directly responsible for the care, appearance, and efficiency of the Men, Battery, Boats, &c., in their respective Divisions.

Duty is carried on by Sections.

In port the section book shows the section respectively assigned to the call, relief, 2nd relief, and watch below.

The Section takes the call at 8 A. M., and this continues for 24 hours.

At sea the 1st Section, for example, will one day answer all calls when the Starboard Watch is on deck, and the 2nd Section all calls when the Port Watch is on deck. The next day the 3rd Section will answer for the Starboard Watch, and the 4th Section for the Port Watch.

When meals are piped the working section of the watch remains on deck until relieved by the working section of the other watch.

For any given 8 days the routine is as follows:

	CALL.	RELIEF.	SECOND RELIEF.	SECTION BELOW.
Sunday,	1	3	4	2
Monday,	4	2	1	3
Tuesday,	3	1	2	4
Wednesday,	2	4	3	1
Thursday,	1	3	4	2
Friday,	4	2	1	3
Saturday,	3	1	2	4
Sunday,	2	4	3	1

The companies of Infantry or sections of Artillery will be formed from the same Division, thus:

Company No. 1 from the 1st Division.
“ “ 2 “ “ 2nd “
“ “ 3 “ “ 3rd “
“ “ 4 “ “ 4th “

If only 2 companies can be formed, then

Company No. 1: 1st section of company from the 1st Division.
2nd “ “ “ “ “ 2nd “
Company No. 2: 1st “ “ “ “ “ 3rd “
2nd “ “ “ “ “ 4th “

The Marines form a separate company or section.

Getting underway, anchoring, mooring or unmooring, those men not especially stationed shall fall in and remain at quarters. For any “All Hands” drill or manœuvre, the “Assembly” shall be sounded, and all the Divisions will go to their quarters. When “All Hands” are called to muster, the Divisions shall be marched to the point designated.

These boats will be manned as far as practicable by the Divisions in whose quadrant the boats are stowed. This crew is the “Regular Crew” and mans the boat at all times for “Landing,” “Arm and Away,” “Distant Service,” “Cutting Out,” “Abandon Ship,” “Drill and Exercise.” Each boat shall have a station for “Manning and Equipping,” and use no other. Additional numbers will be assigned each boat for " Abandon Ship " and " Cutting Out."

Running Crews.—Every morning at 7 A. M. a list of 2 or more boats' crews, taken equally from each Division, shall be posted, and these crews will be on duty for 24 hours.

The regular Coxswain of the boat will be in charge. (See Boat Bill.)

"WATCH, QUARTER AND STATION BILL."

CHIEF PETTY OFFICERS AND SPECIAL BRANCH.

Letter.	Rate.	Name.	Division.	Remarks.
A	Chief Master-at-Arms.		5th	
B	Chief Boatswain's Mate.		1st	
C	Chief Gunner's Mate.		5th	
D	Chief Quartermaster.		4th	
E	Chief Carpenter's Mate.		5th	
F	Equipment Yeoman.		5th	
G	Paymaster's Yeoman.		5th	
H	Engineer's Yeoman.		6th	
I	Apothecary.		5th	
J	Writer, 1st class.		5th	
K	Writer, 1st class.		5th	
L	Writer, 2nd class.		5th	
M	Writer, 3rd class.		5th	
N	Schoolmaster.		5th	
O	1st Sergeant of Marines.		7th	
P	Machinist.		6th	
Q	"		"	
R	"		"	
S	"		"	
T	"		"	
U	"		"	
V	"		"	
W	"		"	
X	"		"	
Y	"		"	
Z	"		"	
AA	"		"	
BB	"		"	

FIRST DIVISION. **FIRST SECTION.**

Watch No.	Watch No.	Name.	Rate.	Gun.	Company.	BOATS.		Mess.	
						Regular Crew.	Abandon Ship.		
111	11								
112	111								
1101	112								
1102	113								
1103	114								
1104	115								
1105	116								
1106	117								
1107	118								
1108	119								
1109	B								
1110									
1111									
1112									
1113									
1114									
1115									
1116									
1117									
1118									
1119									
1120									
1121									
1122									
1123									
1124									
B									

STARBOARD WATCH.

Fire Quarters.	General Quarters.	Collision Quarters.	Clear Ship for Action.	Underway, Anchoring, Mooring.	

SIXTH DIVISION. **FIRST SECTION.**

Watch No.	Watch No.	Name.	Rate.	Boat, Abandon Ship.	Company.	Mess.	Fire Quarters.	Colli Quar
611	61							
612	611							
6101	612							
6102	613							
6103	614							
6104	615							
6105	616							
6106	617							
6107	618							
6108	619							
6109	H							
6110	P							
6111	Q							
6112	R							
6113								
6114								
6115								
6116								
6117								
6118								
6119								
6120								
6121								
6122								
6123								
6124								
6125								

STATIONS.		STATIONS.		STATIONS.		STATIONS.	
SECTION "A."		SECTION "B."		SECTION "C."		SECTION "D."	
T. Door or T. Hatch.	Watch No.	W. T. Door or Hatch.	Watch No.	W. T. Door or Hatch.	Watch No.	W. T. Door or Hatch.	Watch No.
		No.		No.		No.	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	
		"		"		"	

OTE.—There shall be two men for each door. The Compartment will be searched as much as possible and word passed, to see that no one is
. At every drill the men stationed at doors and hatches will see that the rubber gaskets, are free from paint and in good condition, that the door or
s work freely. They shall always make a report to the Division Officer, as to the above conditions.
oors marked * to be kept closed at night when in port.
oors marked ** to be kept closed when at sea.

"BATTLE BILL."

FIRST DIVISION. OFFICERS..

No.	Gun.	Watch Nos. of Guns' Crew.	Watch Nos. of Guns' Crew.	Gun.
1				
2				
3				
4				
5				
6				
7				

Navigator's Detail..

Reserve of the Division..

SEVENTH DIVISION. OFFICERS..

No.	Stations.	Watch Nos.
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

TH DIVISION. OFFICERS...

Torpedo.	Position.	Watch Nos. of Crew.	No.	Search Light.	Position.	Watch Nos. of Crew.
			1			
			2			
			3			
			4			
			5			
			6			
			7			
			8			
			9			
			10			

o. of Magazine.	Position.	Watch Nos. Stationed.	No.	Shell Room.	Position.	Watch Nos. Stationed.
			1			
			2			
			3			
			4			
			5			
			6			
			7			
			8			
			9			
			10			

FORWARD DIVISION.	AFTER DIVISION.
Nos..	Watch Nos..

BATTLE ORDERLIES. SEVENTH DIVISION.

No.	Watch No.	Name.	Rate.	Speaking Tube or Telephone.	Position.	Communicates with.
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

At speaking tubes and telephones; or, if cut in "action," to act as "messengers."

FOOT NOTE.—Orderlies must not press push-buttons longer than two seconds, as continued pressure causes confusion in Central Station
essary, inasmuch, as the annunciator indicates station calling.
When once the Central Station has been called, orderlies must stand by tube until an answer to the message sent, when such be required
Whenever any change in the general character of the action is to take place all stations will be rung up—"attention" called upon Ce
and the bugle will sound "attention."
"Commence Firing," "Cease Firing" will be sounded always on bugle in addition to signal through tubes.

"BATTALION BILL."

OFFICERS.

No.	Rank.	Name.	Boat.	Station for Equipping.	Remarks.
1	Battalion Commander				
2	Adjutant				
3	Ordnance Officer				
4	Signal Officer				
5	Beach-master				
6	Surgeon				
7	Commissary				
8	Chief of Pioneers				
9	Chief Petty Officer				

COLOR GUARD.

No.	Watch No.	Name.	Rate.	Boat.	Station for Equipping.	Remarks.
1						
2						
3						
4						

REMARKS.

COMPANY No. 1. Chief of Company..

SECTION No. 1. Chief of Section..

No.	Watch No.	Name.	Rate.	Rifle No.
1st P. O.				
2d P. O.				
3d P. O.				
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				

Boat..

Station for Equipping..

SECTION No. 2. Chief of Section..

No.	Watch No.	Name.	Rate.	Rifl
1st P. O.				
2d P. O.				
3d P. O.				
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				

Boat..

Station for Equipping..

"AUXILIARIES." Chief of Company..

No.	Watch No.	Name.	Rate.	Boat.	No.	Watch No.	Name.	Rate.	Boat.
THE PIONEERS.					BOAT KEEPERS.				
1					1				
2					2				
3					3				
4					4				
5					5				
6					6				
7					7				
8					8				
9					9				
10					10				
11					11				
12					12				
THE AMMUNITION PARTY.									
1					13				
2					14				
3					15				
4					16				
5					17				
6					18				
7					19				
8					20				
9					21				
10					22				
11					23				
12					24				

"AUXILIARIES."—Continued.

No.	Watch No.	Name.	Rate.	Boat.
		THE AMBULANCE PARTY.		
1				
2				
3				
4				
5				
6				
7				
8				
		THE SIGNAL PARTY.		
1				
2				
3				
4				
5				
6				

REMARKS.

No.	Watch No.	Company.	Section.	Boat.	
		THE COMMISSARIAT.			
1					
2					
3					
4					
5					
6					
		COMPANY COOKS.			
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
		MESS ATTENDANTS FOR OFFICERS.			
1					
2					
3					
4					
5					
6					

"BOAT BILL."

ARGE. OFFICERS ....

.	Watch No.	Name.	Rate.	Provides Arm and Away.	Provides Abandon Ship.
1					
2					
3					
4					
5					
6					
7					
8					
9					
0					
1					
2					
3					
4					
5					
6					

"ABANDON SHIP."

ers ....

....

....

....

ng Out. Nos. ....

"MESSING BILL."

CHIEF PETTY OFFICERS.

No.	Mess No. A.		Mess No. B.		Mess No. C.		Mess No. D.		Mess No. E.		Mess No.	
	Watch No.	Rate.	Watch No.	Rate.	Watch No.	Rate.	Watch No.	Rate.	Watch No.	Rate.	Watch No.	R
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												

No.	Mess Chests, No.	Mess Tables.	Where Kept.	Remarks.
1				
2				
3				
4				
5				
6				

FIRST DIVISION.

No.	Mess No. 11.		Mess No. 12.		Mess No. 13.		Mess No. 14.		Mess No. 15.		Mess No. 16.	
	Watch No.	Rate.	Watch No.	Rate.	Watch No.	Rate.	Watch No.	Rate.	Watch No.	Rate.	Watch No.	Rate.
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												

No.	Mess Chests, No.	Mess Tables.	Where Kept.	Remarks.
1				
2				
3				
4				
5				
6				

PART II.—" ROUTINE."

"WEEKLY ROUTINE."

DAYS OF WEEK.	"ALL HANDS" TO 8 A.M.	FROM 8 A. M. TO NOON.		
	CLEANING AND SCRUBBING ROUTINE.	QUARTERS FOR INSPECTION AT 9.30 A. M. DRILLS, EXERCISES AND INSPECTION.		
1st Monday.....	Clothes, etc.	Setting-up exercises for 10 minutes, including marching in double time.	*Divisional drill. *B*	Test el appl
2nd Monday.....	do. *A*	do.	do.	d
3rd Monday.....	do.	do.	do.	d
4th Monday.....	do.	do.	do.	Test entire plant, eve connected
1st Tuesday	Hammocks.	do.	†Company drill at infantry, artiller or bayonet exercise.	
2nd Tuesday	Mattress covers. *A*	do.	Battalion drill.	
3rd Tuesday	Hammocks.	do.	Company drill.	
4th Tuesday	Mattress covers and bags; blankets once a quarter.	do.	Battalion drill.	
1st Wednesday..	Clothes, wind sails, screens, boat covers and all canvas gear as necessary.	do.	Collision drill, close all watertight doors, and get out collision mat.	Examine elec tonator and cotton prim
2nd Wednesday..	do. *A*	do.	and *C*	do.
3rd Wednesday..	do.	do.	Battery day.	do.
4th Wednesday..	do.	do.	do.	do.
1st Thursday ...	Clean boats; scrub all gear and paint work.	Clear ship for action and general quarters; close battle hatches; exercise with torpedoes..	Test all flood cocks; Ord. inspect magazines and rooms.	
2nd Thursday ...	do. *A*	General quarters; exercise with torpedoes, with incidental divisional drill.	do.	
3rd Thursday ...	do.	. do.	do.	
4th Thursday ...	do.	do.	do.	
1st Friday......	Scrub clothes.	Setting-up exercises for 10 minutes including marching in double time.	Fire quarters	Fleet tactics un and sails.
2nd Friday......	do. *A*	do.	do.	Boat drill, and at di *D* of Comd'g Office
3rd Friday......	do.	do.	do.	of following: A away for such se
4th Friday......	do.	do.	do.	designated, or ins of boats and outf
1st Saturday..	General cleaning day. Clean deck, ladders, gratings, mess tables, benches, chests and all bright wood work. Scrub cotton covered hose.	Inspect bags; correct clothing lists; make out Clothing Requ		
2nd Saturday..		Make out requisition for Small Stores. *F*		
3rd Saturday..		Inspect bedding.		
4th Saturday..				
1st Sunday	Clean ship and get ready for Sunday inspection.	Uniform—Officers, special full dress in port; dress at sea. Inspection of crews at quarters; Articles of War and General		
3rd Sunday	do.	Uniform—Officers, dress. Ordinary inspection and general muster of officers and crew.		
2d, 4th Sunday..	do.	Uniform—Officers, dress. Inspection of crew at quarters; then inspection of ship.		

"WEEKLY ROUTINE."

FROM NOON TO "PIPE DOWN" AT 9.00 P. M.	
AFTERNOON ROUTINE. NG-UP" DRILL AT "EVENING QUARTERS."	
in pulling boats with scrub crews of marines, and recruits; signal class instructed in [signaling.	Test electric search-lights after dark.
do.	do.
E do.	do.
do.	do.
ll, regular crews, oars and sails; signal nstruction.	
do.	
do.	
do.	
signal drill.	Night signals after dark.
do.	do.
do.	do.
do.	do.
Instruction in Signals and :ial instruction of Engineer's Force and arines at Main and Secondary Battery.	Exercise search-light.
	do.
	do.
	do.
gnal instruction.	Making up any omitted exercises.
do.	do.
E do.	do.
do.	do.
ting parties.—Boat liberty, sails and oars not to land.	
do.	do.
do.	do.

A—Every night, circumstances permitting, clothes may be washed from after "colors," in such a part of the deck as may be assigned, until 8.30 P. M., when lines will be triced up and deck washed down.

B—This drill (Div.) to be as the Division Officer prefers.

C—After this drill the Carpenter will examine all the "W. T. doors" and "hatches," "air ports," "sluice gates," "manifolds," "sea connections" and "air ducts."

D—After this drill the Carpenter will examine and test all hand pumps, hose and everything pertaining to the "fire apparatus."

E—The Marines will be included in this drill, under the Marine Officer.

F—Mending Day.

• Divisional drills will consist of detail drill with Main and Secondary Battery; instruction in ordnance; in detail of, care and preservation of Battery and small arms; aiming and pointing; pistol drill, and single sticks occasionally; detail drill at stations.

1st and 3rd Mondays, serve out clean hammocks at evening quarters.

† Whenever opportunity offers the companies will be landed for dress parade and battalion drill. Men will be equipped for service on shore, occasionally, in heavy marching order.

Last Tuesday of first month of quarter inspect diving apparatus and ammunition rooms. Break out hold or storerooms if necessary.

Last Tuesday of second month of quarter overhaul ground tackle and cables.

Last Tuesday of third month of quarter test life buoys and life boats.

C Every Wednesday the Battery will be overhauled after the collision drill. At general overhauling of Battery, Divisional Officers will be present and supervise the work. Each gun with its mount, track and all appurtenances, must be put in thoroughly good condition, as required by the Gunnery Drill Book, and so reported to the Executive Officer, who will report to the Captain.

Last Wednesday of month, test dry gun cotton.

Last Wednesday of quarter, test wet gun cotton.

Third Friday of third month of quarter examination of apprentices as per Art. 868 Navy Regulations.

Saturdays—If weather is clear at "all hands," signal will be made to air bedding; later, six bells, hammocks will be piped up for the same purpose. As soon as decks are cleared up and ship inspected, pipe up bags.

On or about the 15th of each month, issue clothing and small stores.

On or about the 25th of each month, issue monthly money.

Crew will be exercised at night quarters, night fire quarters, and "man overboard," at least once every quarter. Days of the month not provided for will be utilized in making up exercises which have been omitted.

ROUTINE FOR SCRUBBING.

White Bags on........................

Hammocks “ ....

Blankets “ ....

Mattress Covers “ ....

Mess Cloths “ ....

Deck Cloths “ ....

Ladder “ ....

Hose “ ....

Hawser “ ....

Chest } Covers. “ ....

Gun “ ....

Wheel “ ....

Mast “ ....

Cots “ ....

Boat Sails “ ....

“ Awnings “ ....

Wind Sails “ ....

....

....

....

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ROUTINE FOR MONEY, CLOTHING REQUISITIONS.

Clothing Requisitions - - - - on......

Money “ - - - - “ ......

Serve out Clothing and Small Stores “ ......

Serve out Monthly Money - - - “ ......

Make out Conduct Classes - - - “ ......

Air Bedding - - - - - - - - - “ ......

Examination of Apprentices - - “ ......

Permanent Board - - - - - - - “ ......

Inspection of Double Bottoms - “ ......

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Signals and Calls.

Emergency and General Calls.

Notify Central Station.

Sound General Alarms.

Repeat all bugle calls under forecastle and on all decks. Repeat Boatswain's calls on all decks.

Clear Ship for Action.

Boatswain's Call, "Clear ship for action."

General Quarters or Battle Stations.

General Alarm—Bugle Call—Drum.

Close Water-Tight Doors.

Siren: One long blast.

Open Water-Tight Doors.

Whistle: One blast.

Get Up Provisions.

Bugle: Provision call.

Pass the word on all decks.

Abandon Ship.

General alarm.

Bugle: Away all boats.

Pass the word on all decks.

Fire Stations.

Rapid ringing of ship's bell for fifteen seconds. Bugle call for Inspection.

Fire forward: One stroke of bell, one bugle blast.

Fire aft: Two strokes of bell, two bugle blasts.

Getting Underway, Anchoring, Mooring and Unmooring.

UNDERWAY.

Secure Battery, Boats, etc., for sea		All Divisions.
Rig in lower booms		1st and 2nd Divisions.
Rig in danger booms		3rd and 4th Divisions.
Unship gangway,	Starboard	Carpenter's gang and 3rd Division.
	Port	Carpenter's gang and 4th Division.
	For'd	Carpenter's gang and 2nd Division.
Bridge Screens		Quartermasters and Signal Boys.

Mast Covers .... Divisions.
On Forecastle ....1st Division.
Under Forecastle ....2nd Division.
Reeve, overhaul and lead along cat-fall.. } " B " and Stb. Watch
Hook cat and fish.................... } of 1st Division.
Tend stoppers and controllers } ....2nd Section 2nd Division.
Bit and unbit cable }
Man cat and fish falls. All of 1st Division not stationed elsewhere.
At. steam capstan Carpenter (in charge), and Nos..............
Couple and uncouple Wild Cats..........Nos..............
Tend levers, Starboard..................Nos..............
Tend levers, Port........................Nos..............
Chain tierers, Starboard.................Nos..............
Chain tierers, Port......................Nos..............
Lead out and tend hose..................Nos..............

MOORING AND UNMOORING.

Get up clear hawse gear, bit and unbit cable, tend stoppers, range, veer, bring to and pay down cables.......................... 4th Section of 2nd Division.
Shackle and unshackle chain.............Nos................

ANCHORING.

Stand by and let go anchors..............Nos................
Rest of crew, not otherwise engaged, remain at quarters.

PART III.—MEMORANDA.

ACTIVITY.

Men moving about the decks on duty shall do so on the run.

ASHES.

Will be gotten up in harbor by the Engineer's Force, and at sea by the Watch. In each case the working party will see tarpaulins laid on deck and ship's side in wake of Ash Chutes and clean up after work.

ACCOMMODATION LADDERS.

Will be cleaned by the Messenger Boys or by the Divisions to which they belong.

AWNINGS AND CURTAINS.

Will be stowed in............................and parts of the ship to which they belong are responsible for them.

AIRING AND INSPECTING BEDS.

This will be on...

and will be aired in the parts of the ship belonging to the Divisions; all blankets will be fitted with stops.

ATTENTION.

When a man-of-war is passing, the Bugler shall sound the "Attention Call," when every one on the upper decks and in sight will stand at "Attention" until "Carry On" is sounded.

AWKWARD SQUAD.

Those men in the Divisions who are slow, indifferent and ignorant at drill, shall form an Awkward Squad, and be drilled for one hour in the P. M. by one of the Petty Officers of the Division.

BRIGHT WORK, GUN.

Is assigned by each Division Officer.

BRIGHT WORK, DECK.

Shall be apportioned out by the Captain of each part of the ship, who is held responsible for its efficiency.

BOATSWAIN'S MATES.

Boatswain's Mates, of all rates, will carry the whistle and pass all orders and pipes in all the compartments on their decks.

BOATS (See Boat Bill).

No pulling boat is to leave the ship not fully manned. In every boat's crew there is to be one who is an expert Signal Man (wig-wag); Coxswains to have a copy of "Boat Salutes." Each boat to have its recall (see signal book) painted on a tin tag, nailed in Coxswain Box, also Night Recall; Boat Box always in boat. A gong, or bell, will be struck four times at ten minutes before the regular, or extra, boat leaves; twice, two minutes before she shoves off.

Nothing but the regular boat gear is ever to be stowed in boats. At colors Boat Keepers will stand and salute; also when a man-of-war is passing. When under oars, at colors, will "toss" and salute; also when a man-of-war is passing. Under sail or steam, Coxswains rise and salute.

After Boat Drill the Officer of the Division, or those in charge of boats, shall inspect the boats for cleanliness, bright work, paint work, neatness, sails, etc., and report to Executive Officer. Those Coxswains who have an excellent boat shall have extra privileges.

BOAT BOX.

To be kept in the boat.

Contents of. (See page 417, Drill Regulations.)

BOX, MEDICAL EMERGENCY.

Shall be kept in the Divisional Officer's room.

BAG INSPECTION.

Will take place on.. bags to be fitted with two stops on inside of bottom. All clothes to be marked per regulation, and lists of same taken.

BLANKETS.

Will be scrubbed on....................................

BUGLERS.

All the Buglers will sound the colors, reveille, tattoo and taps together; other calls repeated on all decks and all out-of-the-way compartments. Buglers will sleep in such a place that is most convenient for a quick call.

BILGES.

Will not be pumped out until all boats are dropped clear.

BATH ROOMS AND WATER CLOSETS.

For the Crew, will be in charge of

Nos. .... Starboard;

Nos. .... Port.

BATH ROOMS AND WATER CLOSETS.

For Wardroom, Steerage, and Warrant Officers, will be in charge of

Nos. .... Starboard;

Nos. .... Port.

They will be ready for inspection at Quarters.

* * * * * * * * * * *

"A"

INSPECTION.

1. Complement.	Officers.	Men.	Marines.
Number short.	"	"	"
No. absent from duty.	"	"	"

2. How long has ship been under present Commanding Officer?
3. When was ship last inspected and by whom?
4. Is the complement satisfactory?
5. Is the vessel clean and in good order in every department?
6. Were the officers and crew in Regulation uniform and has each man a sufficient number of suits?
7. Are medals of honor and good conduct badges worn at general muster as required by Regulations?
8. Are any suggestions offered in regard to uniform?
9. By inspection of certain bags, taken at random, is the men's clothing properly marked?
10. What is the condition of the bedding?
11. Have all books and charts, affected by notices to mariners, received since ship went into commission, been corrected? If not, give reason in detail.
12. Have the nautical books and charts given all necessary information during the cruise regarding ports and anchorages?
13. Are all station bills properly made out and are they posted in a conspicuous place?
14. Is the ship supplied with a complete set of drawings and plans and with corrected copies of the specifications under which she was built?
15. Is the ship provided with a corrected copy of the Navy Regulations and with a file of Department General Orders and Circulars up to date?
16. Are the Articles for the Government of the Navy read and posted as prescribed by law?
17. Are the instructions concerning water-tight doors and valves, and the care and preservation of the hull and double-bottoms, complied with?
18. Has the order relating to water in the double-bottoms been obeyed (Art. 1593)?
19. Are the Navy Regulations (Art. 157) in reference to saluting the flag at "colors" observed?

20. Is the ship painted as directed by Art. 1594, Navy Regulations?
21. Spar and sail exercises (such as the rig of the ship admits of, timing each evolution).
22. Are copies of Arts. 376 and 377, Navy Regulations, hung up about the ship as required by par. 9, Art. 377, and are the said Articles enforced?
23. What are the smoking orders in the ship (Art. 249, par. 10)?
24. Are the officers' messes in a satisfactory condition and conducted with fairness to all officers and according to the Regulations, are there any outstanding mess debts (Art. 249, par. 11)?

"B."

INSPECTION OF HULL, FITTINGS AND OUTFIT, BATTERY AND MACHINERY.

HULL.

1. Displacement.
2. Maximum draft with maximum coal, provisions and ammunition } For'd. Aft.
3. Freeboard of spar or main deck above L. W. L.
4. Lowest air port above L. W. L.
5. When was the ship last docked, and bottom cleaned and painted?
6. What is the ship's bottom painted with and has it proven satisfactory?
7. What is the condition of the ship's bottom at present?
8. What is the general condition of the outside plating of the ship?
9. Have any structural weaknesses of hull developed since ship was last inspected?
10. Number of compartments in the ship?
11. Condition of each as to metal, paint, cement, water-tightness; undue heat, lack of ventilation, dampness and efficiency?
12. Water-tight doors.
    (a) Do they close properly?
    (b) Are edges free from paint?
    (c) Are gaskets in place and sound?

(d) Are they warped?
(e) Locks?

13. Pumping and draining. Does the drainage system of the ship work well?
14. Number and kind of pumps connected with the Pumping and Drainage.
15. Efficiency of pumps.
16. Are fire mains connected to both steam and hand pumps?
17. Where are the fire mains located?
18. Is there a diagram on board to show which valves should be turned to fill or pump out the water-tight compartments?
19. Rudder, kind? Total area? Does vessel carry any angle of helm in steering a straight course?
20. Screws. Number of blades? Condition of ? Efficiency ?
21. Are the water tanks satisfactory?
22. Quantity of water they hold?
23. What is the condition of the magazines and are they properly stowed and ventilated?
24. How are they stowed?
25. Are they properly lighted and have they any other means of lighting them than by electricity?
26. Are battle lanterns fitted with other than electric lights?

"C."

INSPECTION FOR BATTLE EFFICIENCY.

MAIN BATTERY.

SECONDARY BATTERY.

(OFFICERS IN SERVICE DRESS, CREW IN WORKING DRESS, MARINES UNDRESS.)

I.—CLEAR SHIP FOR ACTION.

1. Time required to clear ship for action.
2. (a) State what was done, and if anything was omitted.
   (b) Were all water-tight doors and valves closed, except those required for communication in action and were those ready to be closed?
3. Was the complete arc of every gun of both main and secondary batteries unobstructed?

4. Where is the station of the Commanding Officer? That of the Executive Officer? That of the Navigator?
5. Are the Commanding Officer's means of communication efficient—(a) With engines? (b) With helm? (c) With battery?
6. Are the means efficient for obtaining and signaling to each gun division the distance of the enemy?
7. Are the means of sending and receiving signals in action efficient?

GENERAL QUARTERS FOR ACTION.

8. Times in which divisions reported ready for action.

1st Division, Commanded by....................
2nd Division, " ....
3rd Division, " ....
4th Division, " ....
5th Division, " ....
Navigator's Division, " ....
Powder Division, " ....
Engineer's Division, " ....
Marine Division, " ....
Surgeon's Division, " ....

9. Were all the divisions properly prepared? If not state in detail defects and deficiencies.
10. How often are the rapid-fire guns mounted in cabins, cleared away?
11. Were all the equipments and spare articles supplied?
12. Were all the men of the guns' crews properly armed and equipped and supplied with ammunition?

* * * * * * * * * * *

SMOKING QUARTERS.

For Crew ....
For Chief Petty Officers ....
For Warrant Officers ....
For Steerage Officers ....
For Wardroom Officers ....

SIDE CLEANERS' GEAR.

Shall be stowed as follows:

1st Division ....

2nd " ....
3rd " ....
4th " ....

Side Cleaners.

Shall be the following Nos.:

1st Division ....
2nd " ....
3rd " ....
4th " ....

Storerooms.

Shall be under the charge of the Yeomen of the Department to which the Storerooms belong.

Towel Lines.

Shall be put up in the Morning Watch, and taken down at the order "Clear up Decks for Quarters." They shall be placed for the Divisions as follows:

1st Division ....
2nd " ....
3rd " ....
4th " ....
5th " ....
6th " ....
7th " ....

Wing Passages.

Will be kept clean by Nos..............................
....

Water Tanks.

After being scrubbed will be coated with cement and water.

Windsails.

Will be scrubbed and looked out for by the Divisions in whose part they are located.

Water Pipes.

Outside of the Engine and Fire Rooms the pipes shall be painted near the valves, as follows:

Sea connection	Black.
Drain connection . . .	Green.
Fresh-water connection .	Gray.

Fire connection . . . . Red.
Exhaust connection . . Blue.

All the Carpenter's gang and Petty Officers in charge of decks shall have a copy of this system.

WASH DECK GEAR AND BUCKETS.

Will be stowed as follows:

1st Division ....
2nd " ....
3rd " ....
4th " ....

WASH CLOTHES, BLANKETS, BAGS, HAMMOCKS.

Will be stopped on as follows:..........................
....
....
....
....

WARRANT OFFICERS.

At 8 P. M. they will turn in to the Executive Officer a "chit," stating what work is to be done on the next day, all the details given, and the number of men that will be required.

WORK.

All the crew shall be kept constantly at work from Reveille to 4 P. M., weather and other circumstances permitting.

WASHING WATER.

At 7 A. M. the Captain of the Hold will serve out so many buckets of water to each Division for washing. He will check off each Division as supplied, and the names of men of the Division drawing the water.

HAMMOCK NUMBERS.

On account of the different arrangement of "hammock nettings" from that of the old-fashioned ships, marking hammocks with the Watch Nos. (red and black) is no longer necessary. A good plan is to have the hammocks marked with the Pay No. of the man. The advantage of this is that a man keeps the same hammock and No. as long as he remains in the ship, no matter to what Division he may be transferred. Marked with the Watch No. (according to the present system) when he is transferred to another Division, he must either exchange hammocks (often getting a poor one in place of one that is clean and well kept), or the No. must be cut off, and a new one sewed on. As the hammock No. simply indicates ownership, the Pay No., which never changes, seems the more practical and better plan.

This system is not to be considered as "hard and fast," for it is elastic, and can be adapted to any class of ships. To the writer's knowledge one Battleship, two Armored Cruisers, and several Protected Cruisers and Gunboats use it and find it simple and effective. The principal object of this book is to have at hand a systematized plan and "blank forms" ready for use. With very little change the "forms" can be adapted to any of the different systems in use. Whether the four (4) part, three (3) part or two (2) part system on the old-fashioned Fore-Main- and Mizzentop is the best, is an open question. But it is much to be desired that some one uniform system be adopted, the reasons for which are too obvious to be discussed here.

DISCUSSION.*

Rear-Admiral FREDK. RODGERS.—The value of this excellent paper is much enhanced, as we know, by the fact that its deductions are from much practical experience gained by its author, Lieut.-Comdr. Schroeder, as the executive of a first-class battleship, in time of war as well as in time of peace.

For obvious reasons, I am in accordance with the principles set forth as desirable for the foundation of a successful and convenient organization. Having approved of them, and, in general, of the organization proposed while in command of the Massachusetts, there can be little for me to say in criticism.

As far as I am informed, there has never been imposed upon the commanding officers of modern vessels of war a uniform system of organization approved by the department. In consequence, individual ideas have prevailed in the various ships, and much labor and thought have been devoted to this matter by the progressive executives of our larger ships. Within the last three or four years, a great deal of experience has been gained in the direction, and the department is no doubt in possession of the results. Various boards have been convened to prepare for the department a uniform system of organization, but while I am not aware that any has been approved or adopted, I believe it practicable now to reach such a result successfully by comparing the various station bills and combining what may "be considered the most desirable features of the best." I am now, as I have always been, in favor of parts of the ship as a basis of the organization. It remains to decide how many parts, and the nomenclature. Experience has shown that two parts subdivided are insufficient for convenience; particularly would this be the case in the latest ships, for instance the Alabama with a 6-inch battery of 14 guns, most of which are mounted in the central part of the ship.

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* The discussion is upon the "Watch, Quarter and Station Bill," by Lieut.-Comdr. Schroeder, in the preceding number as well as upon the above article.—*Editor.*

I fully agree with Commander Schroeder on this point, and suggest the names "forecastlemen," "case-mate men," and "after guard," these three parts to be subdivided into first and second parts starboard and port, and the number in each part to be proportioned to the adjacent battery and the work required.

This division of the watches would permit at any time, if desirable, an arrangement of three watches at night, which would proportionate the large amount of work invariably required during the day.

There are three points touched upon in this article which I would emphasize as desirable.

(1) To have a general mess. No officer or intelligent enlisted man who has had experience with the old messing system and the new will question the great advantages to ship's company gained by a well conducted general mess. The commanding officer should at all times have authority to commute at least one-half the number of rations. I think indeed the old regulation which permitted the commanding officer to commute the rations at his discretion should be re-established, which would permit changes governed by various conditions surrounding a cruising ship.

While the chief petty officers should be allowed their own mess if they desire, I think that all the others should belong to the general mess.

(2) Referring to the question of firemen and coal heavers in the powder division, which always comes up and must be definitely settled, I am convinced by experience that the stations of these men at general quarters should be permanent; that they should be relieved at once if on watch and go to their regular and permanent battle stations. In exercising the powder division, it can generally be arranged to have drills without interfering with the watch on duty.

(3) The handling rooms of the main turrets being isolated from the powder division, the gun divisions of these turrets should always include the men required below for the ammunition supply, and independently of the powder division. It seems to me that the reasons for this are obvious. I can see no advantage to be gained by putting such large marine guards on board ship as is now the custom. On the contrary, as it involves an additional organization, it complicates matters. The marines, apart from their guard duties, can only at best take the place of landsmen, and the continual changes due to the large percentage of desertions from the marines detailed afloat introduce green men, and embarrass the administration of the ship.

Rear-Admiral FREDK. RODGERS.—The Board of Control in my opinion has by inviting opinions and discussions upon the subject of organization on board ship, drawn attention to a matter most important to sea-going officers of the navy. It is fair to assume that these productions will assist materially in arriving at a uniform system or organization to be adopted by the Navy Department.

With this in view Lieutenant-Commander Gove is entitled to the thanks of those interested for the work he has done in preparing his paper.

Without venturing to criticise or discuss this paper in detail, I will only state what in my opinion experience warrants me in saying, and in a general way:

First. To have the organization primarily based upon parts of the ship. The names of these parts, their number and the subdivisions to be adapted to the class of ship, her battery and interior arrangements. In the Massachusetts, two parts of the ship subdivided into first and second parts worked very well, but in the later battleships with large central battery, four parts would probably be necessary for convenience. It is to be understood that the divisions are to be in close touch with the corresponding parts of the ship so that this arrangement in no way complicates the working of divisions in complete accord with the watch bill.

Second. For obvious reasons I believe in the establishment of a general mess. This arrangement has been successfully maintained on board some of our largest vessels with the commutation of only one quarter the number of rations allowed.

Third. It has been and may now be the custom on board a number of our vessels of war to detail one of the relief watches of the engineer's force for duty in the powder division. By this means any one of the three divisions may be called upon to go to the powder division on a sudden call to quarters. I am satisfied by actual experience with both methods that this plan is not advisable and that the men should be permanently stationed for battle quarters. Should some of them be on watch they are to be relieved, of course, without delay.

Fourth. Always have a navigator's division separate and distinct from the other divisions. The only reasons advanced that I am aware of for having the navigator's division divided among the others for drill, etc., is that the navigator's time is so continually occupied that he has none to spare for drills and the ordinary duties pertaining to the care of a division. This is fully admitted, but I have always found it practicable to have the junior officer of the navigator's division, or at least some officer other than the navigator attend to these matters. In port I think the navigator is always able to give his personal attention to his division, which is at best a small one.

Captain H. C. TAYLOR, U. S. Navy.—Few officers will wish to question the facts which Commander Schroeder has laid before us as a result of his long and successful experience as an executive officer of a battleship. I desire to add my testimony in favor of the general or consolidated mess and to emphasize its importance and convenience in the general work of a man-of-war.

On page 339 he has some general remarks to make concerning the marines which should be answered by those who do not share his views. He speaks of "the simple, natural law of letting soldiers constitute the army and sailors constitute the navy." The history of naval organizations does not indicate that it is a natural law for sailors alone to constitute a navy. Many inconveniences doubtless result from having a portion of the crew trained as soldiers, but I believe it to be a necessity to a perfect naval organization in a time of war that a portion of the crew should have that training, and it is probable that the natural law is that which has resulted from the necessities of the case which we perceive to be in history, that there shall be a certain mixture of soldiers and sailors on board ships of war. The evolution of navies in past time indicates this.

It is proper, therefore, for one who differs from Commander Schroeder to say that there are some who would not approve of the existence of but "one uniform, one fraternity, one service." It would doubtless produce a simple and convenient state of affairs, but would not, in the opinion of some officers (myself among the number) produce the highest war efficiency.

It may be added that if we would regard the marines as permanent factors of a ship's fighting power and could rid our minds of the possibility of their being some day removed from men-of-war, we should find it easier to station them. Ways would be found and solutions would occur to us which we do not think of so long as we regard them as transients, liable to be removed from year to year by some regulation of the department or act of Congress. What may come in the future, what drawing together of the two types—the seamen and the marines—into a combination of the two in one type, we cannot tell. Such a move will be largely influenced by the reduction of fireroom forces some day, due to the introduction of liquid fuel and resulting in a large increase to the combatant element of the ship's force. But this growing together into one type is not necessary to war efficiency and the two bodies may remain as distinct as are the cavalry, infantry and artillery in land forces.

With all deference to Commander Schroeder's views I esteem it a grave error for us to advocate the abolition of marines on board ship, for I regard them as one of the elements of war efficiency of naval vessels.

Commander Wm. Swift, U. S. Navy.—Experience in our service in the organization of battleships is as yet very limited, and the attempt to draw general conclusions from such experience may lead to a serious error whereby the efficiency of organization on individual ships will be sacrificed to a system, which, however well designed, cannot in the nature of things, be equally applicable to such a variety of circumstances as we find in our different types of vessels. The efficiency of the ship should not be seriously subordinated to any system of organization in matters of detail merely for the sake of uniformity in the service. Therefore, the organization should be based on some simple arrangement easily understood by the officers and crew and readily adapted to the conditions existing on different vessels.

A most important consideration in our service is the necessity for quickly mobilizing and training a large percentage of our ships' forces in times of emergency. The available force of trained men is very small as compared with the possible demands of the navy, and in time of war with a great naval power, the necessity for absorbing and training a large percentage of raw material must be anticipated as the war progresses. These conditions make of the first importance the answer to the question "How can we most quickly commission, organize and prepare for battle, the vessels of our service?" It seems to me that a condition of first importance in this connection is that the ship's officers should have under their command at all times and under all conditions of battle service, the same group of men. My experience confirms me in the emphatic endorsement of this view.

The subdivision of the crew for ordinary ship duties into four groups, commonly called parts of a ship, under suitable titles, is a natural and satisfactory one. In addition to this, the further subdivision into two watches and two parts of each watch, so that each of the original groups will have its proportion of each part of each watch, is also natural and of great utility. Where, as at present, the usual duties of the ship at sea are alternated in watches and where, with vessels cruising and making passages under steam, the duties at night are restricted in such a way that they can be satisfactorily performed by one-fourth of the working force on deck, it is extremely convenient to have this fourth made up of men from each of the large groups so that the different duties of the ship are properly carried on by men belonging in the vicinity where the duties occur. Another advantage obtained by this system is that in the morning watch when the heaviest work of the day occurs, it is practicable to have available, three-fourths of the working force on deck without in any way impairing the efficiency of the ship at other times. Following this system, the part, whether it happens to be first or fourth, which is on duty at any time, provides lookouts and answers whatever calls may be made upon it, the alternate part only being called upon in emergencies. The method followed is probably quite familiar to many who will read this paper, as it has been frequently adopted within a few years and, from my experience, with great advantage to the general comfort and efficiency of the ship.

The present complement assigned our vessels is inadequate for several reasons. It is based upon the assumption that all men in the ship are present, fit for duty, that the demands of battle service will be of very short duration because the number of men available in the different divisions provide no reliefs for those whose duties are excessively fatiguing, nor for the casualties of an engagement. The use of the engineer's force in the powder division introduces a group of men who are a source of embarrassment for many reasons, even when, as under most favorable conditions, the same men are continually detailed for this work. The substitution of marines for men of the seamen class is an additional embarrassment in the organization, because their training and previous preparation for such duties are not so thorough, and because for this and other reasons, they are not easily transferred about from one duty to another in the same way that men belonging to the seaman branch are; in other words, they are only available for the miscellaneous duties of a ship in the restricted sense. Another emergency which is now of frequent occurrence is the detachment of groups of men from the ships for service on shore. In none of our ships can this be done without seriously crippling the fighting efficiency of the vessel.

Under these conditions, the complements of the ships should be considerably larger than at present, to provide in a satisfactory way for the various difficulties which confront the commanding officer of a vessel in the organization of his crew.

Time will not permit any extended analysis of this interesting paper which deserves the serious consideration of the naval service.

Lieutenant-Commander **Marix**, U. S. Navy.—In reply to your request on behalf of the Board of Control to discuss Lieutenant Gove's "Watch, Quarter and Station Bill," and inviting special criticism and discussion upon part one, I submit the following, regretting that I am not to discuss an article more in accord with my own views.

Whether or not a ship shall be worked by gun divisions, and organized with those divisions as a basis, is the principal question involved; although no one disputes the fact that the efficiency of the battery is the most important object to be attained.

To organize and work a ship by gun divisions does not add to the efficiency of the battery. It is not only necessary to have nothing interfere with the distribution of the guns on board of a ship into divisions, but it is also necessary to have nothing depend upon those divisions. Lieutenant Gove feels obliged to divide a ship's battery, no matter what the ship may be, into four divisions, and probably wishes these divisions to be almost equal in size. This would be necessary were his system adopted.

I claim that the division of guns on board of a ship is pre-eminent; it must stand absolutely alone, and nothing must interfere with it. The Bureau of Ordnance should designate how the battery of each ship is to be divided, and then the ship's authorities will station the men at the guns, having them man the guns in their own part of the ship as far as possible. In this way a ship may have three, or four, or five, or in fact any number of divisions, and the divisions may be unequal in size, yet the battery will be as efficient as it is possible to make it. Vessels of the same class will have the same arrangement, and all vessels will have the best. This would by no means be the case if Lieutenant Gove's plan of dividing every ship into four divisions were adopted. It might apply to battleships where all the turret guns and all the guns of the secondary battery are fully manned; but it could not be made to apply to cruisers of the Philadelphia and Raleigh class for instance. The Bureau of Navigation does not furnish crews for opposite guns. Nor does it seem necessary or desirable to have half of the men at the guns idle, in case only one side is engaged.

I agree entirely with Commander Schroeder in regard to dividing the ship's company into four parts. This system is applicable to every ship in the navy and has always been found perfectly satisfactory. I fail to see the use of Lieutenant Gove's system of four numbers in a watch-number. It is useless to have a watch-number stand for a lot of terms. It has been said that an officer would simply ask a man his number, and would then have all the information he wanted. It seems to me to be much simpler to ask a man what you wish to know, rather than to ask him his number and then enter into the solution of a mathematical problem.

I am opposed to Lieutenant Gove's system of having watch officers do the work of the executive: the care of the ship belongs to him, assisted by such junior officers as the detail may permit, and I see no reason why watch officers should assume that duty. Nor is it in my opinion advisable to have shifting details of men to look out below. They would take no interest in the work, and it would not be well done. On board the Maine all lower compartments and double bottoms were cared for by the berth-deck cooks and men of the torpedo division, and the result was excellent.

Regarding boats, I differ from Commander Schroeder's views, as well as from Lieutenant Gove's, but agree entirely with the former that a boat's crew should always be the same, whether for armed boats, or running boats, or abandon ship.

I am in favor of having each boat's crew composed of a number of men from each part of the ship. It is claimed by those who do not believe in this system that the same officers should always command the same men under all circumstances, a principle which seems to me to be very objectionable. In the army, where the company officers are always thrown with their own men, and with no others, this is no doubt desirable; but in the navy a division officer is also a watch officer, and when in the execution of the latter duty he is in command of all the men, and it would be better for him not to be too much identified with a certain set.

It would furthermore tend to make the ship's company itself cliquey, and instead of having three cliques (sailors, firemen and marines), as we now have, we would have seven or eight cliques on board of every ship. I therefore think it advisable to intermix the officers and men as much as possible.

The principal point to be considered after all is the care of the ship with a boat expedition or a landing party away. The ordnance instructions provide for working the battery with reduced numbers, and if necessary, men from the several divisions could be concentrated to one part. This would be better than having to send a whole division to another part of the ship and having no one familiar with that locality. For a vessel to go into action with a portion of the men away would be a very rare occurrence; but having to take care of a ship with a boat expedition or a landing party away does occur frequently, and no one can deny that a ship will be better taken care of by a reduced force all around, than by the removal of one or more whole parts of the ship, to the utter destruction of the organization.

I believe in having boats' crews manned by men from each part of the ship, and to have a boat's crew of twelve men and a coxswain a unit for the organization of the battalion, two such boats' crews making one section; and all drills, except those at the battery and ammunition, can be by sections.

I am also opposed to the abolishing of the navigator's division. There are certain men on board ship who are always in the navigator's division in action, and they should form one division. In addition to this, there can be a navigator's detail from the gun divisions, supernumeraries at the guns if possible, to work with the navigator's division as occasion requires. By this I mean men at the lead, men at the search-lights, signal boys, men to man the hand wheel in case the steam steering-gear is disabled, and all such duties as will only be required under certain circumstances.

Lieutenant FULLAM, U. S. Navy.—The paper by Lieutenant-Commander Schroeder once more brings the much-discussed and long-neglected question of ship organization before the Naval Institute, and deals with the many sides of the subject in a practical and forceful manner.

It is very surprising that our " New Navy," so universally praised (even by itself), should have been in existence for more than ten years without any recognized system of ship organization. The Greer Board, and following it several other boards have at different times faithfully and laboriously formulated different schemes of organization, all of which have been buried in the archives of the Navy Department. If there has been any good reason for all this delay in the past there is none now after the experience in the Spanish war; and continued neglect to provide some uniform system will be unpardonable.

The trouble may have been that absolute perfection has been required before accepting any plan. But this is never attainable. Any system would be better than none. No system will please everybody. All officers have their personal hobbies and prejudices. Any of the systems thus far proposed, any system whatever formulated by officers detailed for that purpose, would be better for the service at large than the present plan of having as many different systems as there are ships in the navy—an extravagant concession to the hobbies of individuals, and a source of annoyance to the officers and men who are victims of such confusion.

It is by no means probable that a plan can be found that will be applicable in all respects to ships of every type. It is not desirable to attempt this. It would be far more sensible to have at least three different schemes of ship organization—the first for turret or battleships, the second for large cruisers, and the third for small cruisers and gun-boats. It would be easier for officers and men to master the governing principles of three such carefully prepared plans, than it is to learn the hundred different plans now in vogue; and with this reasonable concession to types there would be little difficulty in securing a desirable degree of uniformity in the service. The "Quadrantal" system, for instance, appeared to work well for cruisers, but a modification may be necessary for turret ships. And in the case of gunboats with few officers, the division of the ship into two parts—a forward and an after gun division—may be preferable. It is futile to attempt to organize the Machias and the Massachusetts in accordance with the same plan. This would be to carry uniformity to an absurdity.

Not having had personal experience on board a battleship, I would not venture to criticise the details of Mr. Schroeder's plans. It seems to be a most excellent one, however, and it has stood the supreme test of war, which is enough. We will never make progress in this matter till we trust somebody.

The scheme of organization prepared by Lieutenant-Commander Gove, and published by the Naval Institute, would be an excellent plan for cruisers. It also has stood the test of a thorough trial with great success, and has been worked out with attention to practical details.

Simplicity is a much desired thing in ship organization. Complications should be avoided at all times, and we should not attempt to make the watch number tell too much. The point is that the man *himself* should know his station; and he finds it difficult sometimes, particularly as regards the numerous details for boat service—abandon ship, the battalion, arm and away boats for distant service, and for cutting out. At least two of these four distinct organizations should be abolished—distant service and cutting out. For offensive work ashore or afloat, the one organization—the battalion—is quite sufficient. The circumstances of service whether "distant" or otherwise, simply determine whether the whole battalion, or any fraction of it, is needed, and how the force is to be provisioned and armed. It is absurd to have three different organizations for service away from the ship, involving the whole *personnel* and all the boats. The battalion, or part of it, is always available for any service. Here is a chance to get rid of one complication, one source of confusion.

Mr. Schroeder makes the following pertinent remarks regarding the complications introduced by the presence of marines afloat:

This subject has been previously discussed by the Institute. The majority of officers that have studied ship organization and naval training with care, and with a view solely to efficiency, have agreed with Mr. Schroeder. There are officers, however, who want the marines because they don't like "soldiering," and they say "Jacky" can't do the duty properly. But the presence of marines in small detached companies does not free the naval officer from the disagreeable duty of soldiering, nor "Jacky" from the necessity of making the attempt at it—in which he is always successful in spite of what some naval officers say about him.

If it is desirable to free the navy from soldiering—to keep our men always on board ship—a simple compromise will suffice. Let the marines of each of our naval squadrons be organized as a permanent battalion and assigned to a well-equipped transport attached to the squadron. This ship, officered by naval officers as far as may be necessary, under the orders of the Admiral, would be serviceable for any expedition, and without in any manner interfering with the fighting ships or their organization. In this way the longing of the marine " for life on the ocean wave " would be gratified, the difficulties of ship organization as pointed out by Mr. Schroeder would be removed, and naval officers would be freed from much of the soldiering of which they complain. It is the officer as a rule and not the bluejacket who makes a fuss about the work; and it is even just to say that it is the officer rather than the bluejacket who is responsible for any failure in our landing drills.

In its effect upon ship organization, it is amusing to note the manner in which the navy has put itself on record in the Personnel Bill as regards amalgamation. This much to be desired and very happy solution provides that two of the hardest worked corps in the navy, each with a distinct profession (which have always been regarded like oil and water), shall be merged, while we still have two distinct military bodies handling rifles and great guns on board ship! In other words, we amalgamated where amalgamation was difficult; we failed to amalgamate where amalgamation would have been easiest. We swallowed amalgamation butt-end first by proclaiming that a line officer could be an engineer officer also, and stultifying ourselves by admitting that the duty of a marine officer afloat would be too much for him! Mr. Schroeder shows very plainly that the process of amalgamation should be extended to the military part of the ship in order to simplify its organization. Verily, having swallowed a camel why strain at a gnat? Is it not time to recognize that this very versatile line officer is competent to wrestle unaided with the military end of the ship? When *he* is, the petty officer and bluejacket will not be found wanting.

Commander SEATON SCHROEDER, U. S. Navy.—When I consented to write the paper which appeared in the last number of the Proceedings, I had no idea that another officer was preparing one on the same subject; I knew nothing of this until after mine had been printed, and so some of my strictures were more pronounced upon certain points than might otherwise perhaps have been the case.

Being requested by the Secretary of the Institute to review the present article, I can only say that in my paper is to be found all in which I disagree with the able essayist; and the reasons given for my own suggestions, I suppose, may be considered as arguments against his. I may repeat here that I am not attracted to any plans which sanction the following: Not having a name to apply to a unit composed of men belonging to different divisions but working together on deck; the amount of centralization suggested in stationing men by watch numbers for every duty; having transient crews each day to man any working boats; attempting to divide the engineer's force into permanent sections presumably tallying with their steaming watches; shifting details from the engineer's branch to the powder division.

In regard to the quadrantal subdivision of a ship, it of course *can* be applied, but it does not seem to me that it can be *consistently* applied to a ship having center-line turrets, as is the case in all battleships and (alack!) monitors; certainly, parts of two divisions could not be brought into the same turret. Also, in broadside ships, carrying B. L. R.'s, in which only one side is manned—would the alternate guns' crews of, say the forward half, constitute the first and second divisions? And in that case what guns do the individual division officers command? As I said, this, of course, can be so arranged; but it would certainly result in one division cleaning ship in the vicinity of guns manned by another division, and other minor inconsistencies must frequently appear; whereas in the "old-fashioned" way, as at present applied, no incongruities can arise in any type of ship—at least that has been my experience during three years' service as executive of a 1000-ton ship, and nearly two years and a half as executive of a battleship under both war and peace conditions.

I see no advantage in the proposition to mark the men's hammocks with their pay numbers, and it is, I think, open to these objections: for convenience in piping up and piping down, and for police purposes, the hammocks of the various parts of the ship or divisions should certainly be stowed together, and no hammock stower could verify this on receiving hammocks with pay numbers on them; furthermore, the captains of parts of the ship, machinists, etc., know their men's watch numbers but not their pay numbers, and they would be all at sea at "Air bedding" and on other occasions when they would have cause to lock up a man's hammock. Also the work of the sailmaker's mate would be greatly increased, because no number has to be cut off and a new one sewed on under the present system, two permanent complete sets being always kept ready; whereas every time a new man comes on board he would get a new pay number, and it would require incessant care on the part of the sailmaker to keep his divisions' lists right.

On general principles I am always opposed to change when no material advantage is obtained. This is due not so much to sentiment as to the conviction that the fact of a method having been in force for a long time is in itself fair evidence that there is much to commend it, and it should not be lightly changed unless of a nature which brings it into conflict with new conditions and requirements. There is also no use in needlessly upsetting men's practices. The time has come when some one general system should be adopted without making it so precise and inelastic as not to be applicable to all types of ships. I think the present essayist deserves thanks for his valuable contribution, and for the pains that he has been at to present to us the result of his study of the subject.

Lieutenant-Commander K. NILES, U. S. Navy.—After about six months' experience on board the Massachusetts with the results of Commander Schroeder's views and labors in organization as set forth in his paper, it appears needless to attempt a critical discussion of an organization so thorough, adequate and satisfactory.

With the exception of the suggested assignment of the first hundred numbers to the petty officers, and the sixth, seventh and eighth, to the engineer's force, the actual organization of the Massachusetts is practically in accordance with the paper.

The division system should undoubtedly be the basis of organization in all ships of modern type and I think that it is desirable for convenience to have parts of ships, but I should not have more than two, forecastle and afterguard, which answer all requirements.

The navigator should have a separate division for the reasons set forth. It is true, however, that it is of no great importance whether it is called a division or detail.

In forming the Watch Bill, the arrangement of watch numbers as suggested commends itself as being simple and as giving all necessary information without attempting too much. The practice in several ships of using as many as four digits and indicating the watch, division, part, and individual number, etc., is also satisfactory in practice and it does not seem to be of vital importance which method is adopted, as both systems are effective.

I am inclined to favor the less elaborate one, however.

The general mess system will prove without doubt more satisfactory in the long run than the old way, but it requires careful management and close supervision to make both ends meet now that the sources of income for the mess are so much reduced. It is possible that a cruising ship would find it necessary to increase the income by means of a small assessment.

The formation of the messes should be by divisions, and ratings, and should be permanent except for firemen and coal passers, and all the messes should be in the general mess except that of the chief petty officers.

In organizing the powder division the detail proposed is admirable and I think the weight of argument is in favor of having the same coal passers go to the powder division at general quarters. The necessity of having to draw from the engineer's force is to be deplored, and it is probable that war complements in the future will provide sufficient force to fill these details otherwise.

The detail of divisions for the care of double bottoms, compartments, etc., is very satisfactory and the division officers have a routine as to cleaning, painting, inspection, etc., which enables them to make the weekly reports promptly.

The bills for collision, fire and clear ship for action, boats and battalion are most satisfactory and there is no doubt as to the desirability of adhering to the division as the basis of these bills and the rule that officers shall command the same men at all times.

As a whole I think Commander Schroeder's proposed bills and suggestions cover the ground most thoroughly; and whatever may be the system of watch numbers adopted, the fundamental principles of organization cannot vary much from those proposed.

Captain C. J. TRAIN, U. S. Navy.—I regret that my time has been so occupied that I have been unable to give the subject the attention it deserves. So far as I can judge with a complement usually twenty-five per cent short, Mr. Schroeder's Station Bill gives entire satisfaction on board this ship. I should be sorry ever to see the old names of the parts of the ship given up, nor can I see that anything would be gained by so doing, and I should like to see the name of "waisters" given to the superstructure people.

The general mess of this ship, although in a bad way when I joined, has begun to recuperate, because it has been given special care and attention. Its success or failure depends entirely on the ability of the commissary yeoman. Here a lieutenant has it in charge. but that should not be.

One of the least of the ills arising from the stopping of the sale of beer in the canteen has been the diminution of the fund. which could be used for extra expenditure on the messes. The stopping of the issue by the Bureau of Equipment of mess gear has also a bad effect on the general mess, as the men have now to provide their own mess utensils, with the result that the mess cooks do not take that interest in the mess outfit they would take were it mess property. I hope to see the day when the general mess, so called, is established by regulation, and the commissary yeomen made a body of skilled men.

I should like to see "coaling ship" included in the Station Bill. and made a military exercise, as much as fire quarters or collision drill. Our Navy is still far behind its proper place in the performance of that evolution, if it could be so called.

With Mr. Schroeder's remarks concerning the "unfortunate heir-loom from by-gone conditions," by which I suppose he means the marines, I disagree entirely, but the subject has already been discussed sufficiently.

For Mr. Gove's book, entitled "An Aid for Executive and Divisional Officers," I have nothing but praise. Part III, "Memoranda," seems to be particularly valuable and useful.

Lieutenant W. L. RODGERS.—The paper of Lieut.-Comdr. Schroeder is a very instructive one, and the arguments command my assent in almost all particulars. But as I understand that what revivalists call a "confession of experience" is desired, I venture a few remarks.

There seem to be five principal points in the paper about which opinion may differ.

1. Whether the parts of the ship should appear in the organization.
2. What is the proper place for marines in the organization.
3. The advantages of the general mess.
4. The relation of the boat bill and landing force to the divisions.
5. The proper way of detailing parts of the engineer's force to aid in the powder division.

In regard to the parts of the ship, I served on board the Atlanta, about eight or nine years ago, when she had a crew of over 250 men organized on the old plan in use on vessels with sail power and auxiliary steam. One day the captain changed the organization to one very much like that of the Massachusetts. The plan worked very well from the first and gave no trouble in transition, for which much credit is due to the executive officer, who worked out the scheme.

The four gun divisions became the basis of the organization, and also represented the parts of the ship. The other divisions were each divided into four sections, one of which was attached to each gun division, for arm and away boats, abandon ship, battalion drill, etc. Each gun division officer organized his division, with its section from the powder and other divisions, for all duties. This plan does not seem to differ materially from that of the Massachusetts.

MARINES.

I think it may be said that opinion in regard to the marines has been considerably modified by the Spanish war. The prevalent opinion before the war fully admitted the discipline and excellence of the Marine Corps, but notwithstanding this efficiency, it was generally believed that the additional strength which marines brought to a ship's complement was conferred solely by the numerical increase in the crew. The strength and thoroughness of organization on board derived no advantage from their presence.

The war effected no changes in such views, but what was very clearly exhibited in the campaign at Santiago and Guantanamo was the great advantage an admiral derives from the availability of a powerful landing party under his own orders and independent of the fighting ships. As things happened, the marines were employed in seizing and holding the absolutely essential naval base at Guantanamo. Had it been possible to place a second strong battalion in Cuban waters early in June, it is very probable that a landing force under cover of the fleet's artillery would have been able to capture the Spanish forts at the harbor mouth. Had this been done, the surrender of the city, as well as the destruction of the fleet would have been credited to the Navy alone.

Such considerations afford an indication of the large sphere of usefulness open to the Marine Corps. The political results of the late war are far-reaching, and hereafter it is probable the Navy's work will be far from home. Harmony between commanders-in-chief ashore and afloat is hard to reach, as views and responsibilities cannot be identical. Yet the fleet must secure and control its bases of operation. For such service a body of men like the marines under the orders of the Navy Department, but not necessary to the complement of the fleet, is invaluable.

GENERAL MESS.

The general mess has been a success on those ships which have tried it, but it will never be on a proper footing till the Navy Department makes it obligatory on all ships and provides proper structural accommodation for it. At present the main objection to it is that there may be a loss and waste of paymaster's stores and difficulty in keeping full stores owing to the inoperative presence on board of the old system while the new system is in use on the same ship.

The obvious remedy is to ensure the complete success of the general mess by its full acceptance on the part of the Bureau of Supplies and Accounts. The paymaster will then maintain the necessary reserve of provisions in the ship's storerooms as part of the general mess system instead of as an independent supply as at present. It seems a great advantage to have the boat and battalion bills based on the divisions, both for the sake of having the same officers and men always associated, and because it effects a certain amount of decentralization, allowing divisional officers to arrange and alter details of organization as occasion arises.

In regard to the detail of the engineer's force to the powder division, it is undoubtedly more convenient for the men and cleaner for the ship to have the detail a shifting one, and, besides, all men are exercised. I see no advantage in the permanent detail. The coal-heavers do not have important stations; they are needed only for their strength. It is easy to arrange them in groups of three, with one from each steaming watch in each group. Then if one group is assigned to each station where coal-heavers are needed, the stations are properly manned. This plan I have seen working very satisfactorily.

DEPARTMENT OF THE NAVY.

BUREAU OF NAVIGATION.

WASHINGTON, D. C., *September 21st, 1899.*

SIR:—The following is a copy of a letter received from Admiral George Dewey:

> "There has come to my notice a copy of the United States Naval Institute which contains an article by Lieutenant Carlos G. Calkins, U. S. Navy, purporting to be an historical account of the operations in Manila Bay during my command of the U. S. Naval forces there. It has not been my custom to notice the numerous incorrect accounts of those operations, nor do I desire to engage in a controversy with the writer of the paper mentioned in matters of opinion. But as the article has appeared in a publication which is understood to have the official sanction of the Department, and as it contains statements as facts conflicting with my official reports, I consider it necessary to ask that the Department will request the Naval Institute to publish in its next issue my official report of the Battle of Manila Bay, which is absolutely correct in all essentials."

The Department has directed that the Bureau communicate with the Naval Institute in regard to the above matter, and request that the Institute publish in its next issue Admiral Dewey's official report on the battle of Manila Bay.

The Naval Institute is informed in this connection that it is at liberty to use the letter of Admiral Dewey as well as this letter of the Bureau should it be deemed expedient.

Very respectfully,

A. S. CROWNINSHIELD,

Chief of Bureau.

Secretary

U. S. Naval Institute.

[illegible]

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

OFFICIAL REPORT OF THE BATTLE OF MANILA BAY.

By Admiral Dewey, U. S. Navy.

No. 240 D.] U. S. Naval Force on Asiatic Station,

Flagship Olympia, Cavite, Philippine Islands, May 4, 1898.

Sir:—I have the honor to submit the following report of the operations of the squadron under my command:

The squadron left Mirs Bay on April 27, immediately on the arrival of Mr. O. F. Williams, United States consul at Manila, who brought important information and who accompanies the squadron.

Arrived off Bolinao on the morning of April 30 and, finding no vessels there, proceeded down the coast and arrived off the entrance to Manila Bay on the same afternoon.

The Boston and Concord were sent to reconnoiter Port Subig, I having been informed that the enemy intended to take position there. A thorough search of the port was made by the Boston and Concord, but the Spanish fleet was not found, although, from a letter afterwards found in the arsenal (inclosed with translation), it appears that it had been their intention to go there.

Entered the Boca Grande, or south channel, at 11.30 p. m., steaming in column at distance at 8 knots. After half the squadron had passed, a battery on the south side of the channel opened fire, none of the shots taking effect. The Boston and McCulloch returned the fire.

The squadron proceeded across the bay at slow speed, and arrived off Manila at daybreak, and was fired upon at 5.15 a. m. by three batteries at Manila and two near Cavite and by the Spanish fleet anchored in an approximately east and west line across the mouth of Bakor Bay, with their left in shoal water in Canacao Bay.

The squadron then proceeded to the attack, the flagship Olympia, under my personal direction, leading, followed at distance by the Baltimore, Raleigh, Petrel, Concord and Boston, in the order named, which formation was maintained throughout the action. The squadron opened fire at 5.41 a. m. While advancing to the attack, two mines were exploded ahead of the flagship, too far to be effective.

The squadron maintained a continuous and precise fire at ranges varying from 5000 to 2000 yards, countermarching in a line approximately parallel to that of the Spanish fleet. The enemy's fire was vigorous, but generally ineffective.

Early in the engagement two launches put out toward the Olympia with the apparent intention of using torpedoes. One was sunk and the other disabled by our fire and beached before an opportunity occurred to fire torpedoes. At 7 a. m. the Spanish flagship Reina Christina made a desperate attempt to leave the line and come out to engage at short range, but was received with such galling fire, the entire battery of the Olympia being concentrated upon her, that she was barely able to return to the shelter of the point. The fires started in her by our shell at this time were not extinguished until she sank.

At 7.35 a. m., it having been erroneously reported to me that only 15 rounds per gun remained for the 5-inch rapid-fire battery, I ceased firing and withdrew the squadron for consultation and a redistribution of ammunition, if necessary.

The three batteries at Manila had kept up a continuous fire from the beginning of the engagement, which fire was not returned by this squadron. The first of these batteries was situated on the south mole head at the entrance to the Pasig River, the second on the south bastion of the walled city of Manila, and the third at Malate, about one-half mile further south. At this point I sent a message to the Governor-General to the effect that if the batteries did not cease firing the city would be shelled. This had the effect of silencing them.

At 11.16 a. m., finding that the report of scarcity of ammunition was incorrect, I returned with the squadron to the attack. By this time the flagship and almost the entire Spanish fleet were in flames, and at 12.30 p. m. the squadron ceased firing, the batteries being silenced and the ships sunk, burnt, and deserted.

At 12.40 p. m. the squadron returned and anchored off Manila, the Petrel being left behind to complete the destruction of the smaller gunboats, which were behind the point of Cavite. This duty was performed by Commander E. P. Wood in the most expeditious and complete manner possible.

The Spanish lost the following vessels:

Sunk.—Reina Christina, Castilla, Don Antonio de Ulloa.

Burnt.—Don Juan de Austria, Isla de Luzon, Isla de Cuba, General Lezo, Marques del Duero, El Correo, Velasco, and Isla de Mindanao (transport).

Captured.—Rapido and Hercules (tugs) and several small launches.

I am unable to obtain complete accounts of the enemy's killed and wounded, but believe their loss to be very heavy. The Reina Christina alone had 150 killed, including the captain, and 90 wounded.

I am happy to report that the damage done to the squadron under my command was inconsiderable. There were none killed, and only 7 men in the squadron very slightly wounded. As will be seen by the reports of the commanding officers which are herewith inclosed, several of the vessels were struck and even penetrated, but the damage was of the slightest, and the squadron is in as good condition now as before the battle.

I beg to state to the Department that I doubt if any commander-in-chief, under similar circumstances, was ever served by more loyal, efficient, and gallant captains than those of the squadron now under my command. Capt. Frank Wildes, commanding the Boston, volunteered to remain in command of his vessel, although his relief arrived before leaving Hongkong.

Asst. Surg. C. P. Kindleberger, of the Olympia, and Gunner J. C. Evans, of the Boston, also volunteered to remain after orders detaching them had arrived.

The conduct of my personal staff was excellent. Commander B. P. Lamberton, chief of staff, was a volunteer for that position and gave me most efficient aid. Lieut. T. M. Brumby, flag lieutenant, and Ensign W. P. Scott, aid, performed their duties as signal officers in a highly creditable manner. The Olympia being short of officers for the battery, Ensign H. H. Caldwell, flag secretary volunteered for and was assigned to a subdivision of the 5-inch battery.

Mr. J. L. Stickney, formerly an officer in the United States Navy, and now correspondent for the New York Herald, volunteered for duty as my aid, and rendered valuable service.

While leaving to the commanding officers to comment on the conduct of the officers and men under their commands, I desire especially to mention the coolness of Lieut. C. G. Calkins, the navigator of the Olympia, who came under my personal observation, being on the bridge with me throughout the entire action, and giving the ranges to the guns with an accuracy that was proven by the excellence of the firing.

On May 2, the day following the engagement, the squadron again went to Cavite, where it remains. A landing party was sent to destroy the guns and magazines of the batteries there. The first battery, near the end of Sangley Point, was composed of two modern Trubia B. L. rifles of 15 centimeters caliber. The second was a mile further down the beach, and consisted of a modern Canet 12-centimeter B. L. rifle behind improvised earthworks.

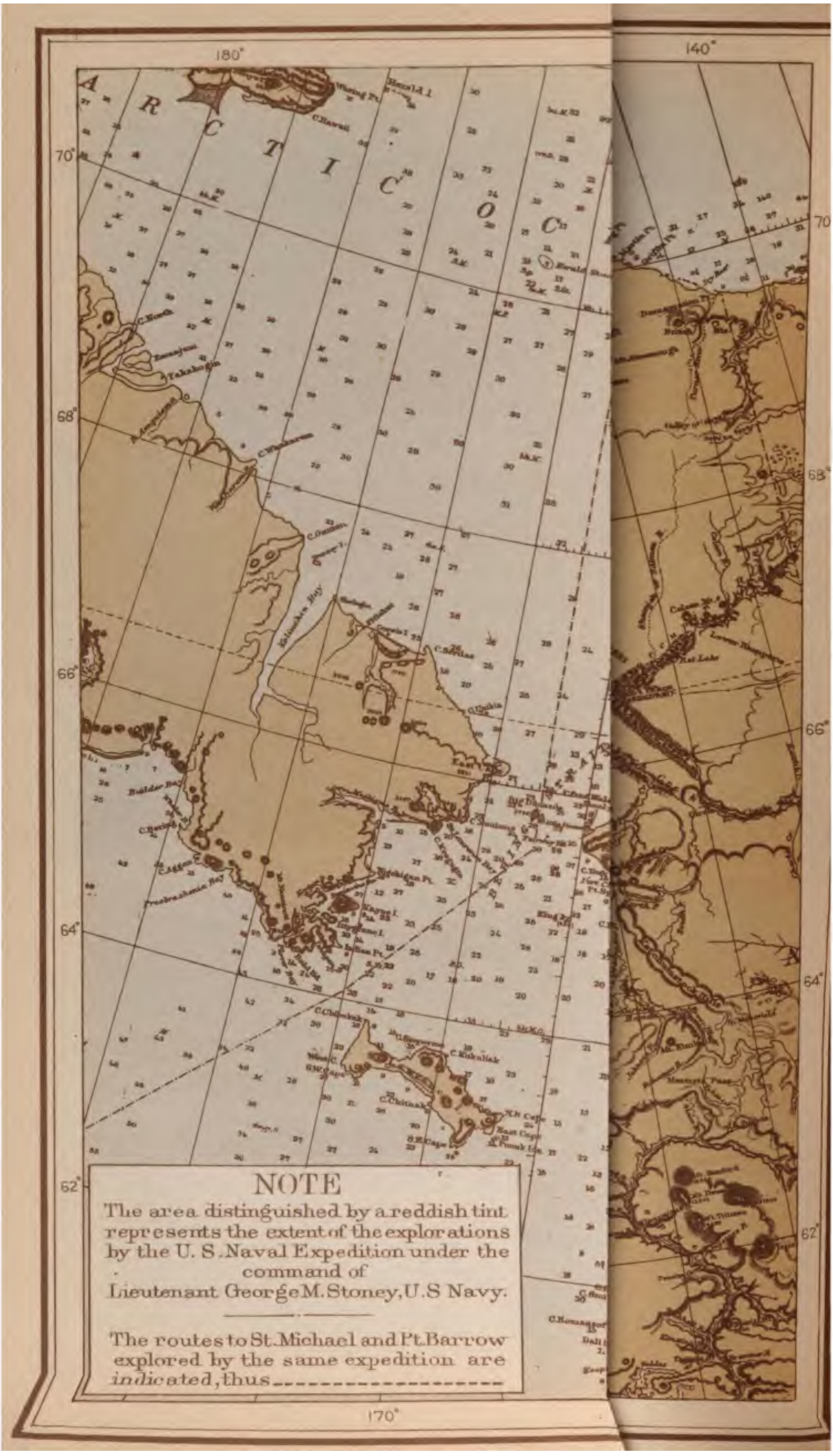
On the 3d the military forces evacuated the Cavite Arsenal, which was taken possession of by a landing party. On the same day the Raleigh and Baltimore secured the surrender of the batteries on Corregidor Island, paroling the garrison and destroying the guns.

On the morning of May 4 the transport Manila, which had been aground in Bakor Bay, was towed off and made a prize.

Very respectfully, your obedient servant,

GEORGE DEWEY, *Commodore, U. S. N.*,
Commanding U. S. Naval Force on Asiatic Station.

The SECRETARY OF THE NAVY, *Washington, D. C.*
(Bureau of Navigation.)



NOTE

The area distinguished by a reddish tint represents the extent of the explorations by the U. S. Naval Expedition under the command of Lieutenant George M. Stoney, U.S Navy.

The routes to St. Michael and Pt. Barrow explored by the same expedition are indicated, thus ------------------

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

EXPLORATIONS IN ALASKA.

By GEORGE M. STONEY, Lieutenant, U. S. Navy.

INTRODUCTION.

In submitting the following pages the writer disclaims any idea of attempting to write a book. His object is to give, in narrative form, an account of the experiences and observations made by himself and the officers of the expedition sent under his command, by the Hon. Secretary of the Navy, Wm. E. Chandler, to explore Putnam, or Kubuck, Rivers, discovered by the writer, and the country in Arctic Alaska, north of it—a section never before visited by the white man.

The hearty willingness, intelligence, energy and efficiency of the officers and men composing the expedition enabled him to cover a much greater extent of country than was at first contemplated.

A full report of the exploration was submitted to the Hon. Secretary of the Navy on the return of the expedition, some ten years ago. It was highly approved and sent to Congress, accompanied by a strong letter from the Secretary of the Navy, urging its immediate publication, as the data were of special value. Congress ordered the report printed. In some way the papers have mysteriously disappeared.

It may seem to some rather late for this publication, but since the country is still unknown to the public, and the writer has received so many inquiries on this subject, both from those interested in Alaska and those expecting to visit the country, he submits this for two purposes: 1st, to give those who were the pathfinders the credit for their hard work, endurance and suffering; 2nd, it may be of interest to some and prove of more value to those visiting the country.

I.

My first visit to northwestern Alaska grew out of my connection with the U. S. Arctic Relief Ship Rodgers, which was sent to the Arctic Ocean in search of the Jeannette Expedition, under Lieut. De Long, U. S. N. The story of the sufferings and hardships of the party, and the loss of that ill-fated ship is well known, as is the manly heroism displayed by the officers and men, of which every American may well be proud.

The natives of the vicinity of the disaster were specially kind to the destitute officers and men, supplying many of them with clothing, and sheltering and feeding all hands through a severe arctic winter until relief came in the spring.

To reward them for their kindness, Congress, the following year appropriated a sum of money to buy presents for them, and as one of the officers of the vessel I was detailed to make the distribution of the same.

I took passage from San Francisco in the spring of 1883, in the U. S. Revenue Cutter Corwin, Captain M. A. Healy, U. S. R. M., with the presents on board. We arrived at St. Lawrence Bay in July, and the distribution was soon after made.

As the Corwin was bound further north, and I could not get south until her return, I determined to employ the intervening time in looking for a large river reported by the natives as emptying into Hotham Inlet, an opening of Kotzebue Sound, Northwest Alaska. The report of the existence of such a river is mentioned by Captain Beechey, R. N., who surveyed these coasts in H. M. Ship Blossom, 1826-27, but as far as known, no white man had ever visited it.

Steaming across to the American side, the Corwin left me on a sand-spit, near the mouth of Hotham Inlet, with the "dinghy," one white man, Tucker, Miunuck, a native from Norton Sound, and provisions for seven days. She then proceeded on her cruise.

I secured the services of another native, Ounalana, from a village near by, and started to search for the mouth of the river. We reached a stream after two days' hard work, and were soon lost in the intricacies of what proved to be an extensive delta.

MASTER C. F. PUTNAM.

After eight days of extreme hardship, pulling about sixteen hours each day, and being nearly devoured by the mosquitoes,* we made the head of the delta, forty-five miles from the coast or outlet. The main stream, which fed the several delta channels, had every indication of being what was reported—a large river. We worked our way some forty miles further up, when we were compelled to turn back for lack of time. We had but seven days' supply of provisions to start with, and beyond that had to depend upon what the country afforded, and I to meet the Corwin at the time agreed upon. Fifteen days after leaving me, she picked me up again at the same place, and started south. I reached San Francisco October 8th.

I reported my discoveries to the Honorable Secretary of the Navy, Wm. E. Chandler, and requested that I be ordered to make further exploration of the stream, stating that I was the *first white man* to visit it, and I believed that it would prove to be an excellent highway into the heart of Arctic Alaska. I also suggested the name of "Putnam" for this river, in honor of Master Charles F. Putnam, United States Navy, the officer of the Rodgers, who lost his life while gallantly trying to aid his imperiled shipmates.†

My request was granted and the schooner Ounalaska, of forty-nine tons, was ordered to be fitted out for the trip, with six months' provisions and stores. Later, a twenty-eight foot navy steam cutter was added to the equipment, and $200 worth of articles suitable for trade with the natives. The vessel was put in commission March 18, 1884, and I assumed command. Her crew consisted, besides myself, of Ensign J. L. Purcell, Gunner Cushman and eight men, with Dr. Reed of San Francisco, who shipped as "apothecary," in order to accompany the expedition.

The following order was received:

NAVY DEPARTMENT, Washington, D. C., April 1, 1884.

SIR:—The Ounalaska having been fitted out for the purpose of carrying a party to Hotham Inlet to make an examination of the river emptying into that inlet, reported by you to the Department in November last, you will, when in all respects ready, proceed to sea with the vessel under your command and make the best of your way to Hotham Inlet.

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* See note on "Mosquitoes" in the continuation of this paper in No. 92 of "Proceedings."

† In substituting others for the long native names of the rivers and lakes; also in naming mountains, I have chosen those of men who have advanced or done Arctic exploration.

You are authorized to touch at such ports between San Francisco and your destination as you may deem necessary.

While it is desirable to obtain information in relation to that portion of Alaska, its resources and its inhabitants, you are directed to so regulate your actions as to not only give the latter no cause for offense, but, on the contrary, to endeavor, by courtesy and kind treatment, to impress them with the interest which the Government represented by you has in all its people.

The log-book of the Ounalaska will be carefully kept in conformity with the instructions from the Bureau of Navigation, and, in addition, you will keep a journal or remark book of the cruise, which you will embody in a report upon your return to San Francisco.

You will arrange your movements so as to arrive with the Ounalaska in San Franscisco not later than the 1st of November next, and you are not to extend your examination of the river and the surrounding country to such length as to prevent you from complying with this part of your instruction.

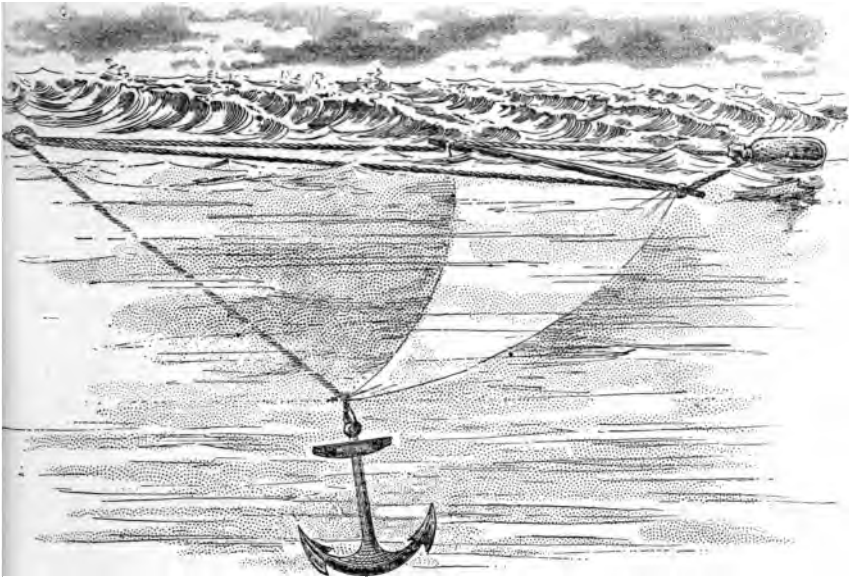
Very respectfully,

W. E. CHANDLER, Secretary of the Navy.

Lieutenant Geo. M. Stoney, U. S. N., Comdg. U. S. schooner Ounalaska, Navy Yard, Mare Island.

In accordance with the above the Ounalaska sailed from San Francisco April 13, 1884, and reached Ounalaska May 20. The passage up was very rough. One gale of unusual severity was successfully weathered by the use of a drag and oil, in a way that it may be well to explain. A triangular sail with a drop of six feet was lashed to the steam cutter's mast, and a seventy pound anchor was hung by a short line to the opposite end of the sail. From the three corners of the sail, lines were led, forming a bridle, and to this bridle a four inch hawser was made fast. A regulation canvas bag three-fourths filled with lard-oil was slung by a span from the end of the mast, so as to ride opposite the center of the spar. The mouth of the bag was sewed up, the sides were irregularly punched with numerous sail-needle holes, the whole apparatus was put over the weather bow and sixty-five fathoms of line were veered to it. It trended three points off the bow and kept the schooner within three or four points of the wind. The motion of the waves, working the bag, caused the oil to squirt out of the needle-holes, and it so smoothed the heaviest combing seas that they reached the vessel more like ground swells than the waves of a heavy gale. The schooner at the time was under a close-reefed triangular mainsail.

We remained at Ounalaska rating our chronometers until May 27th, when we left for the Bogoslof Island, some fifty miles westward, to inspect the new volcano reported to have recently begun action. I made extended investigations of the volcano and vicinity, a report of which was sent to the Smithsonian Institution, with a number of specimens, land and marine, which were collected.* We then stood northward, running a line of soundings, till we met heavy ice, twenty miles south of St. Matthew's Island, when we turned to the eastward.



DRAG WITH OIL-BAG.

While standing eastward the character of bottom indicated the presence of a codfish bank. We hove to, got out lines, and in a few hours caught enough codfish to supply all hands for three weeks, besides salting down a couple of barrels for future use. They were of excellent quality, weighing from thirteen to seventeen pounds apiece, and so numerous as to justify the conclusion that I had struck a regular cod-bank—a fact worthy of mention, as it was generally held that these fish do not get so far north. This bank extended from long. W. 168° 45′ to Nunivak Island, between the parallels 60° and 60° 22′ N.

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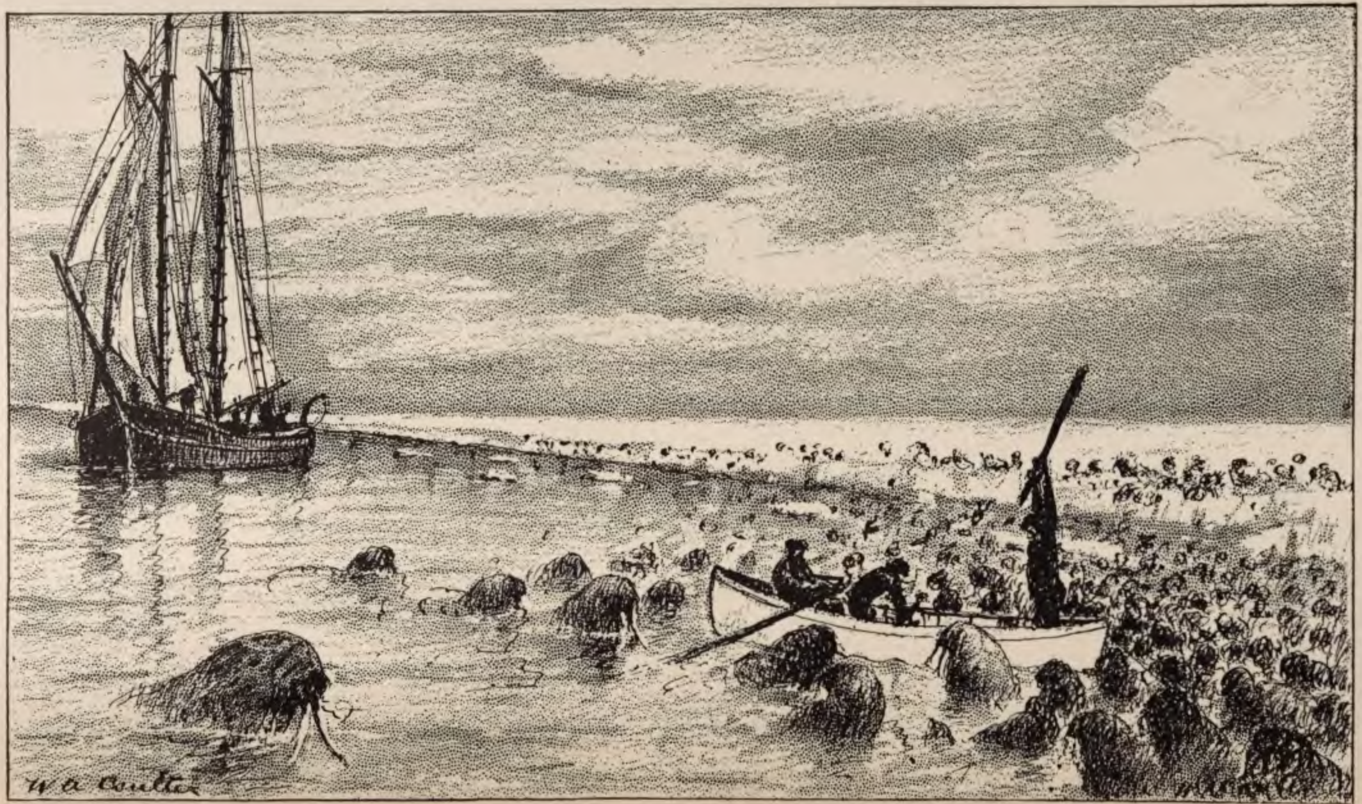
* Notes on Volcano Sinking.

After establishing the geographical position of the west end of Nunivak Island, which had been charted ten miles too far to the east, we stood away on June 13th, for St. Michael's, the chief port of the Alaska Commercial Company. Their Agent, Mr. Lorenz, and his assistant, showed us every kindness. I here engaged an interpreter, Aloka, the offspring of a Russian serf, and a Norton Sound native, Unga-look, who was nicknamed "Riley" on account of his having but one eye, as a guide.

On June 23rd, we started for Bering Strait, and as the ice was well to the southward we stood along the American coast, which was reported clear by the natives, but on June 27th were headed off fifteen miles north of Sledge Island. The many walruses on the ice showed that its strength was too great for forcing our way. Wishing to get a walrus specimen for the Smithsonian Institution, I left the schooner in the "dinghy" with the Doctor and one man, pulled over about half a mile and landed on the ice. Picking out the best specimen, a large male animal, I shot it, and started towing it off to the vessel. While doing so, we were attacked by a school of a hundred or more walruses. They would strike under the boat and rise all around, trying to get their tusks over the gunwale. It became a fight for life. We stood up in the boat and fought them off with boat-hooks and oars. As is generally the case on such occasions when a rifle is most wanted, I could not get hold of mine as it was in the bottom of the boat, under other articles. The fight lasted only a few minutes, but it seemed like a lifetime, until the rifle could be gotten out. One shot frightened them all away, but they were not half so frightened as were those in the boat. To be in a small boat with the water alive with walruses, the blowing of the animals causing the water to foam, and to hear that terrible sound that only a mad walrus can make, is calculated to cause any one's hair to stand on end.

The walrus was gotten aboard the vessel and skinned. The flesh was kept for the natives in St. Lawrence Bay. I knew what we would have given for some fresh walrus meat during our stay with them when the Rodgers was burned. The stomach and



A FIGHT WITH WALRUSES.

intestines were examined for specimens. Seventy-eight feet of the latter were measured and examined, and there was found altogether, only a double handful of pebbles ranging from the size of a pigeon's egg to that of a pea. This surprised me for I could not see how these animals existed. The walrus always follows the ice, keeping on the edge. The natives claim that they live on mussels and clams which they dig with their long tusks from the bottom, in shoal water, and that when the ice works down into deep water during the winter, they have to live on their fat, like the bear. To check their hunger they swallow these pebbles which keeps something in their stomachs. That often they become so poor that they swallow a lot of these pebbles to aid them in diving. I afterwards examined many walruses' stomachs and intestines, finding mussels and clams, but in no case fish. The fact that the walrus is much fatter in the fall than in the spring proves they must get more food in higher latitudes, than they do when they go south with the ice in the winter. I think, however, that the pebbles get in their stomachs when they are swallowing the mussels.

The walrus as food is not bad, especially the flippers, which, when boiled taste not unlike pigs' feet. A young walrus's hind quarter makes a very good roast, unlike the seal which has a rank taste. The liver of the walrus is good, and frozen walrus was much sought after by the Rodgers crew during their stay in Siberia.

Heading to the westward we worked along the edge of the ice, and on June 30th made St. Lawrence Bay, Siberia. The inner harbor, where the Rodgers was lying when burned, was still closed with ice, so we anchored off Cape Nuniagmo, an excellent place for watering ship, and there learned from the whalers that Kotzebue Sound was full of ice, and there was no hope of getting into Hotham Inlet for a time.

A gale coming on from the southward, we got under way and stood clear of the land for ten miles and lay to, heading to the southward and eastward. A dense fog set in which lasted thirty-six hours; when it lifted I found the schooner had drifted forty miles to the northward, through Bering Strait into the Arctic Ocean. For forty-eight hours I tried to beat back but could not do so on account of the strong current setting through the strait. July 3rd, we came to anchor under the lee of East Cape, Siberia, where we found the whale ship Ohio, of New Bedford, Captain Ellis, master, who kindly gave me three hundred and sixty gallons of fresh water. The next day we stood over towards the American side. In latitude 66° 04′ N., longitude 168° 17′ W. we met heavy ice which had to be worked through to get to the shoal water where it could not close in on the schooner. Thick weather prevented observations until July 9th, when the land was made, about forty miles to the southward and westward of Cape Espenberg, and a lead enabled me to stand along the shore and across Kotzebue Sound to the mouth of Hotham Inlet, where I came to anchor July 10th.

Sounding out and temporarily buoying a channel over the bar, a mud and sand-bank about one thousand yards wide with eight feet depth on it at low water, we crossed over. At high water, and when the wind is from the southward and westward, two fathoms can be carried over. Winds from northward and eastward give the least depth. After crossing, a depth of three fathoms was carried in the channel for twenty miles, increasing in places to seven fathoms. Ten miles up the inlet we came to anchor off the lowest native settlement on the inlet. The village was much the same as when visited the preceding year. Having made all necessary arrangements for guides, we began working up the inlet. The wind being light, the current strong and the pilot ignorant, the Ounalaska went hard and fast aground. We laid out both anchors, hoisted out the steam cutter, and after eight hours of hard work floated again in three and one-half fathoms of water. I put the steam cutter in running order and decided to leave in her at once to explore the Putnam River. The following orders were given Ensign Purcell:

U. S. SCHOONER OUNALASKA,
At Anchor, Hotham Inlet, Alaska, July 16, 1884.

SIR:—On my departure from this vessel you will take command. The following are your instructions during my absence: As soon as the wind is favorable you will take the vessel to the mouth of the Putnam River and there await my return. You will, as soon as possible, land in a secure place near the vessel three months' stores. You will take especial care to avoid fire aboard the vessel, inspecting the hold, all lights and fires frequently. Should fire break out and gain hopelessly on you, land everything as soon as possible; better scuttle the vessel than let her burn up. Burn wood instead of coal in galley and stoves. The log will be kept as directed by the Bureau of Navigation. Establish the latitude and longitude of the mouth of the Putnam River, and measure a base line. Measure the mouth of the river as accurately as possible. Take accurate tidal observations, amount of current, rise and fall, etc. Get all the information you can that will be of use to the Department. Be specially careful to avoid any difficulty with the natives. When they visit the vessel give them small presents. Use persuasion and do not use force unless actually necessary to save the vessel and lives of the crew. This you cannot be too careful about.

I will probably be back by September 1. Should anything happen me you will take the vessel back to San Francisco, Cal., and report to the Department, leaving Hotham Inlet not later than September 15, and reaching San Francisco by November 1. By no means remain longer than September 15 without further orders, though you leave me behind. Touch at such ports as you deem necessary. At Ounalaska you will get chronometer ratings and caulk the vessel. While I am away you will make all necessary repairs on the vessel that can be done.

Accept my warmest thanks for the deep interest you have taken in this cruise, and my gratitude for the aid you have given me in carrying out, so far, my plans.

Very respectfully,
GEO. M. STONEY, Lieut., U. S. N., Comdg.

Ensign J. L. Purcell, U. S. Schooner Ounalaska, Hotham Inlet, Alaska Territory.

On July 16th I left the Ounalaska, in the steam cutter, with the "dinghy" and a six-ton skin-boat in tow. The expedition consisted of myself, three of the crew, Aloka the interpreter, four natives, and outfit and provisions for forty days.

The first day only ten miles were made when camp was pitched on Nimyuk sand-spit so as to get wood. There were here a few deserted huts which I wished to use as fire-wood, but objections were made by the natives, who protested that their destruction would cause the death of the former occupants. This was inconvenient, for the driftwood on the spit was poor and proved very unsatisfactory—steam could not be kept up with it for any length of time. It made a strong, quick fire, but gave little heat, and in three hours a boatload would be consumed, necessitating frequent stops to replenish, which was hard work, for often it had to be carried on the back a quarter of a mile, and the mosquitoes were so annoying as to interfere with work. The next day we went on, and towards evening it blew fresh from the east, causing a lively sea to run, that came over the launch and nearly extinguished the fires; so we made sail and ran for the beach, bailing to keep from swamping. Making the lee of a sand-spit, we landed and went into camp to await better weather, where we remained, the following day making repairs. I covered all the steam pipes with sheet lead and the exposed parts of the boiler with fire-clay and mud. This jacketing proved of much service, preventing radiation, and enabling steam to be kept up. The deserted huts at this camp were used for fire-wood, the natives preferring to sacrifice their superstitions rather than carry wood long distances. July 19th, entered the mouth of the Putnam River, and camped on a small creek.

From July 20th to August 13th was spent in going up the river in the steam cutter. After ascending about two hundred and seventy-five miles, the current became so strong, and the sounding out a channel in the low river so tedious, that I left the cutter in charge of the machinist, and proceeded in the skin boat. Having tried paddling with poor results, I resorted to "tracking," dividing the party into two crews, myself leading one, and my best man the other. Turns were taken on the drag, a forty fathom seal-skin tow-line made fast to the boat one-third the distance from the bow, with three loops at the other end fitting around the shoulders and under the armpits. This mode of traveling was kept up twelve hours a day for five days, until the Su-look-pow-vuck-to-ark river was reached, when the men became exhausted from the hard work. All suffered from sore feet, caused by walking over rocks and stones. Six miles before reaching the above stream the tracking was through rapids, with a current from six to seven knots, setting around and over many large boulders, among which one fathom of water was carried.

I learned from natives that the Putnam had its rise among several large and extensive lakes. As one of them on the north side was said to be near, I left the skin boat and crossed the country to visit it, taking with me one of the crew, the others being yet unable to travel, and four natives carrying a canoe, four days' rations, blankets, oilskins, sextant, compass, a shot-gun, two rifles and ammunition, each person having about thirty pounds' pack. After a fatiguing journey of one day we arrived at the lake, which I named Lake Selby. I crossed it in the canoe, sounding as I went, and finding no bottom at eighteen fathoms.

I ascended the mountains on the north side of the lake and determined the latitude by meridian altitude of the sun, and the

TRACKING UP PUTNAM RIVER.

height by barometer. As my camp on the river was visible from the mountain, I located it by bearings; also the position of the lake. This lake abounded in fish—I was told they were of the salmon species and very large—some of them measuring six feet. The peculiar features of the shore and islands indicated a glacial formation.

Completing my observations, I returned to the boat and decided on starting back to the schooner, as the season was getting late and my orders from the Department were positive. This I did reluctantly, as everything was favorable for the further prosecution of the work.

The month of July was one of incessant rain, and as the party was exposed all day and sometimes at night, we found it extremely unpleasant. On the 24th there occurred a thunder-storm of extraordinary violence. The thermometer suddenly fell 9° F., and the barometer rose .15 in.; hailstones two inches in circumference fell for twenty-five minutes; the rain poured down in torrents; forked lightning flashed vividly and unceasingly; and the roar of thunder was incessant and deafening. During the storm the wind was from the northward. Then it fell calm and remained so for a time, and at its termination came from the southward. The temperature of the water that fell was 38° Fahr. During August no rain fell. The heat of the sun was powerful, ranging from 80° to 100° F. during the middle of the day, while at the same time in the shade it was from 60° to 70° F. The greatest heat was 110° F. No especial inconvenience was felt from these exposures. Sunset was followed by a rapid fall in temperature and heavy dew. Towards midnight it became cold and frost formed, and sometimes thin ice made on small, still pools. Returning down the river, it was noticed that the water had fallen, exposing numerous sand-banks. This low water the natives attributed to there being no rainfall in August.

After reaching the schooner, finding that I had a week to spare, having made the descent so rapidly, I determined on exploring Selawik lake. Ensign J. L. Purcell was detailed for the work and given the following orders:

U. S. Schooner Ounalaska,
Hotham Inlet, Alaska Territory, August 22, 1884.

Sir:—You will take charge of the steam cutter Helena, and with a crew of four men—C. J. Huebner (M. A.), Wm. Ready (Mach.) and two

Indians, and rations for seven days—proceed without delay to Selawik Lake. Explore said lake and the mouths of the different streams that flow into it.

You will not remain longer than six days from this vessel. If the work cannot be done in that time, return immediately. If Selawik Lake prove to be of little extent, and the work can be done in forty-eight hours, you will extend your triangulation on Putnam River as far as the third outlet.

You will keep a regular log during your absence, and, in addition, keep accurate notes of all you see—natives, country around lakes, etc. In fact, find out all you can that will be of interest to the Government.

Since it is reported that there is no driftwood in Selawik Lake, nor timber on its banks, you will take with you five hundred pounds of coal and use it with the driftwood you get at the mouth of Putnam River before entering Selawik Lake.

Should the water in Hotham Inlet fall to any extent while you are away, I will drop the schooner down to the mouth of the inlet, where you will join me.

On your return report in writing what you have seen and done.

Very respectfully,
GEO. M. STONEY, Lieut., U. S. N., Comdg.

Ensign J. L. Purcell, U. S. N., Hotham Inlet.

During Ensign Purcell's absence stores were stowed on board and all preparations made for leaving. A supply of driftwood gotten for the galley, so as to save the coal for the steam cutter, proved of good service, for the cutter was constantly used to tow the schooner, and only a little wood is found in the lower part of the inlet. Ensign Purcell returned August 26th, and submitted the following report:

LIEUTENANT GEO. M. STONEY, U. S. N., Commanding U. S. Schooner Ounalaska,

SIR:—I respectfully submit the following report in relation to the exploration of Selawik Lake, Alaska Territory, by the party under my charge, in obedience to your order of August 22, 1884:—

Early on the morning of the 22d of August, the party consisting of Julius Huebner (Mast. Arms), W. H. Ready (Mach.), two natives, Ounalana and Riley, and myself, left in the steam launch, carrying a canvas canoe and complete camping outfit and provisions for six days.

At 8 A. M. the same day I landed on the sand-pit at the entrance of Selawik Lake and remained until meridian for the purpose of taking observations for latitude and longitude, while the natives were engaged in cutting a supply of wood in anticipation of finding none in the lake. At noon started ahead, following the shore line to the eastward and southward, heading for the successive headlands and well-defined bluffs as they came into view, and carrying along two fathoms of water (sand and mud bottom) until 8 P. M., when I came to anchor in a small cove formed by a projecting sand-spit, where we went into camp.

That night observations were obtained for latitude and longitude, and again next morning; we broke camp and followed the shore along as on the preceding day until noon, when we reached the eastern shore of Selawik Lake, where observations for latitude were obtained. At this point a high hill afforded a clear view over the entire basin in which Selawik Lake is situated.

The shores of this lake are high, yellow clay and sand-bluffs, having a height varying from seventy-five to one hundred feet, backed by a rolling, boggy ground extending into the interior and rising often to high detached mountain peaks, interspersed with deep gulches and ravines through which streams of water are discharged into the lake during the spring of the year. At this time they were mostly all in a stagnant condition.

The bluffs are just like those which form the southern and western shores of Hotham Inlet, and are continued all along the south shores of Selawik Lake, extending to the eastward beyond, thence in a general direction to northward and eastward and making a gradual sweep to the north, and finally west to the valley of the Putnam River, forming one large basin. Within this basin I was enabled to trace two rivers and three lakes, viz.: Selawik River and a small river, a small lake and a large lake called the Inland Lake. The last two lakes are connected with Selawik Lake by the two rivers flowing through a low, marshy strip of country covered with a thick growth of brushwood in many places and tall coarse grass.

There are many lagoons communicating with the rivers through narrow channel ways.

After obtaining a latitude position I began searching along the east shore of Selawik Lake for the mouth of the river nearest to us, but soon found it impossible to approach within three-quarters of a mile of the shore on account of a low mud flat making out therefrom.

After proceeding N. by W. for five miles the launch was anchored, and with the two natives in the canoe, I endeavored to reach the shore, which was finally accomplished after considerable wading through the mud and carrying the canoe on our shoulders. Having reached the shore and proceeded but a short distance, the stream of water first seen during the forenoon was found, and, by sounding, a channel about thirty yards wide and ten feet deep was discovered and extending west (true) into Selawik Lake. Through this channel the launch was brought at midnight and camp made on the right bank of the river near an uninhabited native village.

The next morning I started up this river and reached the inland lake, passing, in the meantime, through a smaller lake, the expansion of the river. The river has its source in Inland Lake and flows W. by S. in a very winding course for two miles, when it expands into the above-mentioned small lake four miles long and two wide, contracting afterwards to its regular width of seventy-five yards. It runs its winding course three miles more and discharges into Selawik Lake by two mouths about a mile apart. The depth, of eight feet to five fathoms; the banks are covered with grass to the water's edge; also, there is a good deal of brushwood on them. Huts are scattered about and a number of graves were noticed, most of them about two years old. Only one family was found living on the river, consisting of a young native twenty-five years old, his wife twenty years old, and a small boy of three. They seemed hardy, active and intelligent, and in habits and appearance like those of the Putnam. Their hut was mound-shaped, made of brushwood covered with grass and mud, with an entrance through a small hole next to the ground. The height of the house was five feet in the center and the diameter about six feet. Scattered about were a few spears for catching fish and birds. At the time of our visit they were catching small whitefish in a trap made of brush placed across a narrow channel, connecting with one of the many lagoons, and having above it a funnel made of slats allowing the fish to pass through but one way. The river abounds in these fish. We were compelled to boil them, as the natives objected to frying or broiling because to do so would make the fish leave the river and never return. Many Selawik Indians live on this river and all come here to fish in September, when the river is full of fish and at this time they lay in their winter supply.

An examination of Inland Lake showed the water to be shoal; an attempt to find a channel leading to Selawik River was unsuccessful. A narrow channel five miles long in a northwesterly direction was found, but it shoaled to a foot in depth not far from the outlet of Selawik River.

The depth of water in the lake was five feet at low tide, and outside the channel there was no water deep enough for the launch. The lake is of considerable extent. The tide ebbs and flows to and from Selawik Lake. Two days' observations showed a rise and fall of two feet; strength of the flood, one and five-tenths knots; of the ebb, two and eight-tenths knots.

Returning, the north shore of Selawik Lake was observed, but nothing important noted except a small river entering it to the eastward of the Putnam River. Many sand-spits make out at various points around the lake for half a mile, forming small shoal coves. Keeping clear of these spits, two fathoms can be carried entirely around the lake.

Brushwood and small quantities of driftwood are all that can be found about Selawik Lake or the lakes and rivers to the eastward. The driftwood is found on the sand-spits and is used by the natives for house-building, being gathered in the spring when the heavy southwest winds and strong tides bring it over from the Putnam River.

During the return we met the Selawik Indians coming home from the rendezvous in Hotham Inlet. There were about a hundred of them, including men, women and children. In every respect they are like the Putnam natives, with whom they are on the best of terms, often intermarrying. They were kind and showed great pleasure at meeting us. Many presents were given them, and we parted leaving them happy and contented. They reported the existence of a small shoal lake to eastward of Inland Lake, in size like the expansion of the small river.

The water in these lakes and rivers is fresh. Leaving Selawik Lake and going to the eastward it becomes discolored, but is still good for use at this time of year.

Observations were taken whenever practicable. The last two days heavy weather prevented observations to correct the north shore line of Selawik Lake.

On the mud flats in the eastern part of Selawik Lake I saw geese, ducks, curlews, snipe and swan, and on the land back of the high bluffs plenty of grouse. Very respectfully,

Your obedient servant,
JOHN L. PURCELL, Ensign, U. S. Navy.

Lieut. Geo. M. Stoney, Commanding Expedition.

On August 27th the Ounalaska got under way and was towed down by the steam cutter to Nimyuk sand-spit. Between this spit and the next a bar with six and one-half feet of water intervened—a month previous nine feet had been carried over at high water. The low water was probably due to the high winds. In order to cross, the schooner was lightened by landing a large part of the stores and outfit on a point three miles beyond Nimyuk. The channel, very narrow and only twenty feet wide in places, was staked out and the vessel kedged over. No deeper water could be found anywhere in sounding across the inlet. There were many sand-ridges about the bar but the main channel here, as in all cases in the inlet and entrance to same, was always indicated by a soft mud bottom. It took two days of sixteen hours each to kedge through this winding channel. All the natives were employed, the men laying out the kedge and the women helping at the windlass. Without this assistance I could never have gone through, for three of the crew were sick, one with congestive chills, one with jaundice, and the third with general debility, and Mr. Purcell was laid up with a badly sprained ankle.

Two much praise can not be given these natives for their honesty, generosity, and ready assistance; all the stores were lying unwatched on the beach, and although natives were camped all about them, nothing was touched; not even such articles as tobacco, tea, sugar, etc., could tempt them.

After crossing, stores were restowed on board, and on September 3d we got under way, and anchored off the trading station, at the mouth of the inlet to water the ship, the water in Hotham Inlet being too salt for drinking purposes. We began carrying water in buckets from the lagoons; but the natives dug holes in the beach about twenty feet from the water's edge, which soon filled up with good fresh water, so I used them to finish my supply. People desiring fresh water should dig a hole in the sand beach about six inches deep and after allowing the water to settle, take it for use; as fast as it is bailed out more runs in. It is thought that this good water runs in from the lagoons near by.

The next day we sounded the outer bar and got only seven and three-quarters feet, though three fathoms had been carried up to it. The wind being favorable and the water rising, I determined on trying to get over, engaging the natives to follow in skin boats to assist in hoisting in the steam cutter; so on September 7th all sail was made and the schooner bumped over. Getting outside, we hoisted in the cutter, paid off the natives, and the journey south was begun.

On September 13th I communicated with the natives in St. Lawrence Bay. They remained grateful for their presents and I gave them a few trade articles. Nothing new concerning the U. S. S. Rodgers was gathered. September 16th, made St. Michael's. Discharged interpreter and guide, and left the next day. September 26th, reached Ounalaska. Rated chronometers, caulked schooner above the water, and took in thirty tons' rock ballast, and on October 7th left for San Francisco.

We came near being lost in the tremendous seas in Unalga Pass. The vessel was undoubtedly saved by Captain Hague, of the Alaska Commercial Company's steamer Dora, who kindly came to my assistance. I would advise no sailing vessels to use this pass. The heavy seas and strong currents render them helpless.

The weather on the passage down was unusually severe, and we were obliged to lie to four times, once for forty-eight hours. Most of the trip was made under single reefed foresail running before the wind. We arrived at San Francisco October 26th, and the following month the Ounalaska was put out of commission.

II.

The results of the preceding expedition were embodied in a report, accompanied by a chart, to the Honorable Secretary of the Navy. The mode of surveying adopted was as follows: Single altitudes and equal altitudes lor longitudes, and meridian altitudes for latitudes, using sextant, artificial horizon and chronometer. The variation was obtained by using time azimuths with the standard compass set up on shore. The method of course and distance was used in measuring between observation points. The width of the river was ascertained by firing a rifle from the water's edge on the one bank so as to hit the bank opposite at the water-line when the range in yards was read from the sight bar. The drift of the current was found by heaving the log.

The work done was from force of circumstances only approximately correct, and when submitting it I requested to be sent back to accurately triangulate and survey the rivers and country, and explore as much as possible the interior of Arctic Alaska. In obedience to verbal orders I submitted plans for a sixty-foot flat-bottomed steamboat, and also in general terms what I proposed doing, the nature of the work and its requirements. In accordance with my request the order was issued giving me the boat, also the steam cutter Helena, used before. In addition I was furnished a small portable steam sawmill to be worked by connecting it with the boilers of either boat, and $2,000 with which to purchase trade articles to exchange for winter clothing, dogs and sleds, and to hire natives. Provisions for twenty months were supplied, most of which were stores left over from the Greely Relief expedition.

All the details were completed by April 26th. The question of getting north then arose. The Secretary of the Navy desired that a vessel should remain in the north with me, and with that view I was sent to Puget Sound to inspect two Government schooners lying there. Neither was large enough, so I was authorized to charter one in San Francisco to take the expedition to Hotham Inlet and leave it there. The two-masted schooner Viking, three hundred and ninety tons, M. Denevig, Master, was the one selected.

The expedition consisted of myself, in command, and the following officers: J. L. Purcell, Ensign; M. L. Reed, Ensign; W. L. Howard, Ensign; A. V. Zane, Passed Assistant Engineer; F. S. Nash, Passed Assistant Surgeon; and twelve men. The large stern-wheel steamboat, named the Explorer, was put in commission April 26th, and hoisted on board the Viking by the Mare Island Navy Yard sheers, with the steam cutter Helena; and stores and outfit were all stowed. Everything was ready when the following telegraphic orders were received:

NAVY DEPARTMENT, Washington, May 1, 1885.

LIEUTENANT GEO. M. STONEY, San Francisco, Cal.

You are expected to proceed under your general instructions to explore the Putnam River and vicinity.

W. C. WHITNEY, Secretary.

Two days later the expedition sailed from San Francisco, and on June 6th anchored in Ounalaska, where we rated the chronometers, leaving June 9th, and on June 27th arrived at St. Michael's.

Here I shipped, as ordinary seamen, the interpreter Aloka and "Riley" (Ounalook), whom I had employed on my previous expedition, and "Bill" (Oukutkoon). The families of these two last were taken along to keep their husbands contented, and to sew, wash, dry fish and assist in various ways. Each family had one child. "Bill's" wife was Annutkan, and his child, Alluke; they were known to us as "Mrs. Bill" and "little Sophie." "Riley's" wife, Shopshuuck, and his child, Toggarack, were called "Mrs. Riley" and "little Riley." Riley and Bill were paid the equivalent of $15 per month in trade articles that in reality cost the Government but $4. The wives and children were fed and occasionally given small presents.

Mr. Lorentz, the agent of the Alaska Commercial Company, kindly furnished me with double reindeerskin winter coats (parkies), for each man of the expedition, two large skin boats (bijdera), and many smaller articles of especial benefit, such as steel runners and bolts, etc.

June 30th we left St. Michael's, the natives being greatly concerned lest they should never get back, and on July 5th anchored off Cape Niniagmo, St. Lawrence Bay. We found the inner bay frozen solid and the outer bay full of heavy drift ice. The natives, our helpful friends in the day of the Rodgers, came on board and were given a good meal of biscuit and molasses. They thought I had more presents for them, and though disappointed were none the less kind. I traded with them for one hundred skin boots and some deer and sealskins. The drifting ice was too heavy to remain long at anchor, so we stood through Bering Strait. July 7th Ensign Purcell was invalided home, taking passage in the whaling ship Ohio, Captain Ellis, bound for San Francisco.

July 9th we anchored off Hotham Inlet, having made in four days the same distance that, on account of ice, had required two weeks on the first expedition. I hoisted out the steam cutter, and having sounded out the channel over the bar, passed in the next day and anchored off the native trading settlement.

On the 11th, while beating up the inlet, the schooner went aground. I lightened her by hoisting out the steamboat Explorer. This was a serious undertaking, as the boat, weighing twenty tons, occupied most of the schooner's deck. I put two chain straps around her forward and aft, hooked in two mast-head tackles, came up the starboard rigging of the schooner, and set the tackles well taut. I then put four jack-screws under the boat and jacked her up, keeping a good strain on the mast-head tackles at the same time, until she was high enough to clear the schooner's rail. Then I put two spars well slushed, across the rails so that twenty feet of end projected over to starboard, and rested the boat on them, shoving her well over. Topping lifts were then gotten from the mast-heads to the inboard ends of the spars, and thwartship tackles were put on the boat; the topping lifts and thwartship tackles were manned and then launched broadside on. As soon as she was in the water, I began preparing her for immediate use.

On the 13th we kedged the schooner off, and took her to within ten yards of the beach—a sand-spit called Pipe-spit. There we made our first camp and called it Camp Purcell; and having built a pontoon bridge from the schooner to the shore, began discharging. Perishable stores were stowed in a house made of old canvas, and a log house was built out of driftwood, in which to cache provisions. July 17th, I left for Putnam River, with Ensign Howard, Passed Asst. Engineer Zane and six men, in the Explorer and Helena, towing three skin boats loaded with provisions. Ensign Reed, as next in rank, was left in charge of the remaining men at Camp Purcell to proceed with the discharging.

Proceeding up the river, on July 19th, I established Camp Depot, on the right bank, about ninety miles from the mouth, where I discharged boats and set up the sawmill, using the

Helena's boiler to supply steam. It worked perfectly. Leaving the Helena and stores in charge of Ensign Howard, I returned to Pipe-spit. July 22nd the schooner Viking left, the Captain having received a written acknowledgment that she had fulfilled the terms of the charter. On the 26th I left Pipe-spit again for Camp Depot with the remainder of the stores, Ensign Reed, and the rest of the party. A reserve supply of provisions, for use in case of accident, had been cached in the wooden hut at Pipe-spit, and a native was hired to watch them.

Passing Camp Depot, where Mr. Reed was dropped and Howard and Zane taken up, I pushed on up, and on July 30th established Camp Gloomy on a high bank of the river, about one hundred miles further above. I chose a bluff, because the river was rising. Having landed the provisions, I left Mr. Howard in charge, and went back to Camp Depot, to pick up Mr. Reed and party and the remainder of the provisions, returning on the 8th with all hands and the provisions. Leaving Ensign Reed in charge, I again started further up the river with a party and half the stores.

On August 11th I found a favorable place, very central, for establishing winter permanent headquarters, from which to send out sledging expeditions. It was a dry, elevated spot on the right bank of the river, at the outlet of a small deep creek, about three hundred miles from the mouth. The place was well wooded, and the creek afforded good winter harbor for the two boats. I called this camp Fort Cosmos, after a club in San Francisco, of which the officers were members. Having discharged the boats, we built a log house for perishable stores, established an observation station, set up the saw-mill, using the Helena's boiler for steam, and began sawing lumber. I then left Mr. Howard in charge and returned to Camp Gloomy for Mr. Reed and party, and the remainder of the stores, and on the 17th all hands and the stores were landed at Fort Cosmos.* The party was then divided into gangs—of fishermen, wood cutters, carpenters, and sawmillers—and the work of preparing for the winter was at once begun. Getting this well under way by August 20th, I left in Explorer for Pipe-spit, to purchase seal-oil, for the dogs, seal-rope, and other articles that might prove of use during the winter, and also to get some necessary stuff left in the cache. I reached the depot August 22nd, and having made the purchases,got some more dogs, overhauled and restowed the cache, placing the spare chain of the Explorer across the top and piling the extra coal around, I left it in charge of a native watchman and returned to Fort Cosmos, arriving August 30th.

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*The boats not being large enough to carry all my party and stores at once, and not wishing to have them separated by too great a distance, I made the advance up by stages as described.

The question of the moment was how to feed the thirty-six dogs we had with us. Paymaster General Smith had failed to provide the pemmican ordered by the Secretary of the Navy, and at least thirty-five hundred salmon would be required for them and the natives during the winter. Hauling the seine did not supply enough; so as the season was advancing and the fish going higher up the river, I decided upon going with a party up stream to catch and buy a sufficient supply—first cutting the seine in half as it was too long, and placing all the sinkers in the half used to weigh it down. The trip was not very successful; the fish were being caught in great numbers by the natives, but they would sell only a few, and on returning I determined on sending another party out later. On September 9th I sent Ensign Howard, Passed Asst. Eng. Zane, one man and some natives, to catch and buy fish and to explore the adjacent mountains. The native women were sent along to dry the fish. The party carried fifteen days' provisions and tracked up the river with dogs in one of the skin boats, returning on the 23rd, having secured two thousand fish and explored the mountains.

By September 11th, all the leaves of the trees had fallen. Only a few whortle and salmon-berries remained. On the 13th, thin ice formed on still water, and on September 21st we saw the last of the geese and ducks; only a few chipper-birds remained. Running creeks froze. Winter had set in and the weather became too cold for outdoor work.

September 24th, drift ice came down the river. The natives began building their winter house. The next day I took the Explorer and Helena up the creek, breaking the ice to make a passage, and laid them up for the winter. The boiler and engine were taken out of the Helena, and by means of shears she was then hauled up on the bank and turned bottom up. The Explorer was left in the creek, and the ice which formed about her was broken up every morning and evening until November 22nd, when she was allowed to freeze in solid to the ground, when all the ice was cut clear of her side, leaving her bottom resting on the ice. Then at a distance of four feet from her, a two-foot ditch was cut in the ice all around the boat extending to the bottom of the creek, so as to provide for any cracks that would otherwise have a tendency to strain her, and also to allow the water to flow by without filling the basin that had been cut for her. September 26th, all hands moved into the winter house. I posted the winter regulations and commenced fire-drill and drill to resist attack.

III.—Fort Cosmos.

The first consideration was the house. Owing to the difficulty of keeping a house warm in the winter, I decided to build partly below ground, though advised not to do so by the traders at St. Michael's, on account of dampness. I believed this could be avoided by building in light, sandy soil. The site chosen was a high, sandy spot, sixteen feet above the river bank, and from plans that I had prepared on the way up, work was at once begun. An excavation 39x42 feet by 3 feet deep was made, and heavy posts thirteen inches in diameter and eleven feet to sixteen feet long were sunk four feet into the ground at the corners and at equal intervals between them, having their sides and inboard faces slabbed off. Grooves one and one-half inches deep, by two inches wide were sunk in the sides. Logs slabbed on three sides, with tongues cut at their ends, were fitted into the grooves of the posts, with the rough sides outward, and chinked with reindeer moss. The lowest of these logs, the sleepers, were as thick as the posts; the others were smaller. The frame of the house was proportioned so as to have a height of six feet along the walls on the inside and give to the roof a pitch of five feet.

The roof was of plank, over which was put eight inches of grass, and then six inches of dirt. The excavated dirt was banked up on the outside of the walls as far as the eaves. Openings were cut for window and a door, and double windows and a heavy door were put in. On the inside, posts were set in the ground with mortises cut in them for receiving the sleepers and beams. The house was partitioned off, and all living quarters lined with painted canvas.* The sides of the bunks were lined with straw between canvas and logs, and the bottoms were covered with one and one-half inch plank on six inches of straw. In the galley and drying-rooms the floor was of faced saplings. Bearskins were put on the floors of both officers' and men's quarters.

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* I would specially recommend tarred building paper for the roof. When the snow melts in spring the paper would prevent leakage.

A butt containing one hundred and four gallons of water was mounted high up in one corner of the drying-room, connecting by pipes with the water-back arrangement in the galley, which kept the water warm. A small rubber hose was attached to the butt, that could be led to any part of the house to extinguish fires, and fire-buckets filled and ready for use were kept around the butt. There were twenty-eight inch cast-iron box-stoves set in boxes of sand in the officers' and men's quarters; their pipes and the galley pipe all led to the chimney, for which the smoke-stack of Explorer had been utilized, in the drying room, where the washed clothes were hung to dry. Coolers of drinking water were in the officers' and men's compartments. Over the galley, a 27x24 Westwood range, there was a large tin hood connecting with a pipe made of empty milk-tins which led into the smoke-pipe and carried off most of the galley odors. There was also a tin cover to the water-butt to keep out dust and hold the heat. The water-back arrangement was a success. I consider it an excellent one for use in an Arctic ship. It required no extra fuel, and kept the water in the butt at about 100° F., never less than 90°, and often 120°. If used on board ship, I think all the water needed could be had by melting snow. The traders when told of the contrivance immediately took steps to procure one.

Six months' provisions were placed in the store room, and the remainder in a hut outside, visible from the windows. There were two standing lights in the drying-room over the carpenter's bench, and the machinist's bench. In the quarters hanging lights were used.

The house as above described and arranged made a comfortable home. There never was any dampness until late in the spring when the constant rains made the roof leak a little. A careful record of the wet and dry-bulb thermometer never showed a difference less than 10°. Indeed, so dry was the air that evaporating pans of water had to be used on the heating stoves. Nor was there any difficulty in keeping the house warm. The authorized temperature was 65° and it was seldom lower, but often higher, when the front door was opened to keep it right. No ceiling was put in the house as at first intended, because it would have made the quarters too warm.

After taps at 10 P. M., the front door was opened for fifteen or twenty minutes to cool the house for sleeping, and all fires hauled except a light one in the men's quarters for the comfort of the man on watch. In the morning, when all hands were exercising, all the doors were opened and large fires made in the stoves.

THE ROUTINE.

Daily winter routine was from November 1 to March 1.

8.00 A. M.	Call all hands.
8.30 “	Breakfast. Soon after men make up their bunks.
9.30 “	Turn to. Fill butt. Measure ice and rise and fall of river. Make up officers' bunks. Clear house of people. Open all doors. Keep heavy fires. Executive officer inspect quarters.
11.30 “	Serve out lime juice, an officer to be present, who then also inspects the dinner.
Noon.	Dinner.
1.00 P. M.	Turn to. Get wood for stoves.
4.00 “	Fill butt. Knock off work.
4.30 “	Studies—officers instruct men as they desire.
6.00 “	Supper.
6.30 “	Turn to.
8.00 “	Haul galley fires and report.
10.00 “	Taps. Out lights. Haul stove fires. Inspection by officer. Report all secure for the night.
	Men not allowed in bunks between 8.00 A. M. and noon, and 1.00 P. M. and 4.00 P. M.

WEEKLY ROUTINE.

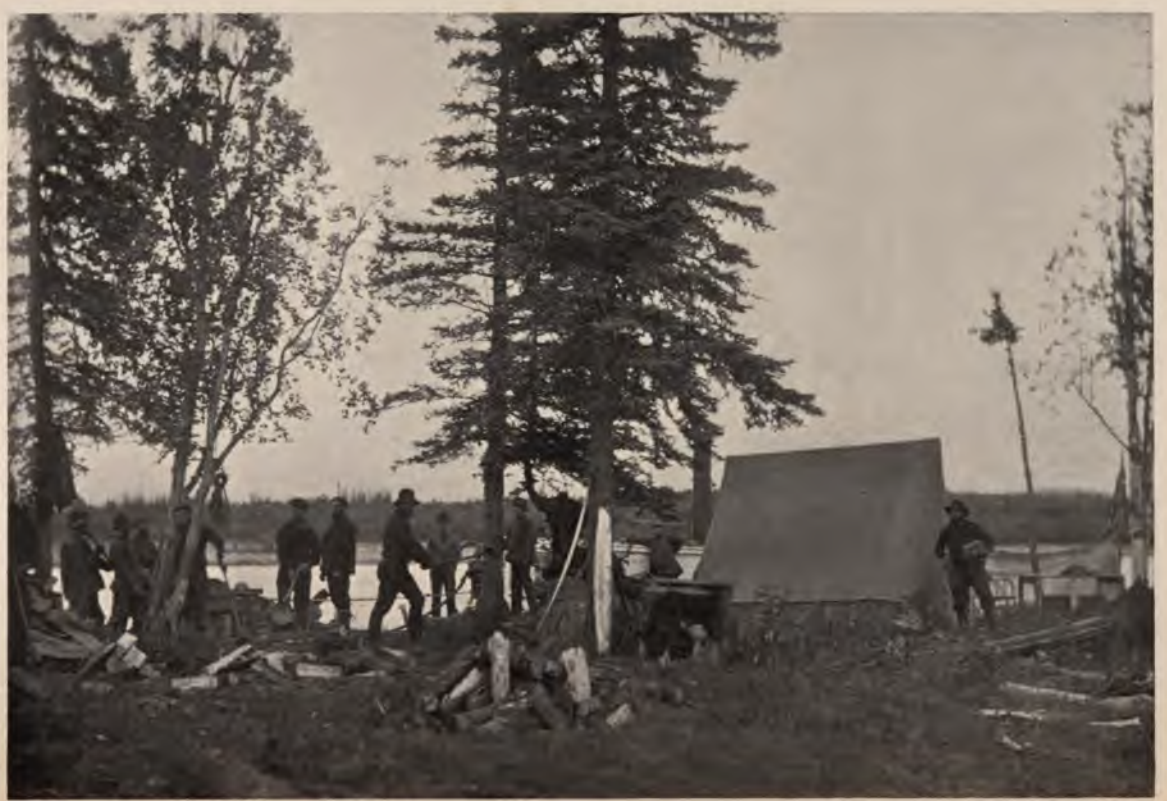
Sunday.	9.30 commanding officer inspect men, rifles and quarters.
Monday.	Officers wash clothes.
Friday.	Men wash clothes. Fire quarters.
Saturday.	Thoroughly clean quarters. Issue weekly rations.

Every other week, air bedding.

MONTHLY ROUTINE.

First Sunday.	Read articles for better government of the navy.
On the 1st day.	Medical examination of the party.
On the 12th day.	Weigh party.
Once a month.	General alarm; prepare for an attack.

The man on watch relieved every two hours.



SITE OF FORT COSMOS.

Spring Routine, March 1.

7.00 A. M.	Call all hands.
7.30 "	Breakfast. Make up bunks.
8.00 "	Turn to.
Noon.	Dinner.
1.00 P. M.	Turn to.
5.30 "	Knock off work.
6.00 "	Supper.
6.30 "	Turn to.
10.00 "	Taps.

Special attention was given the bills of fare. Officers and men lived alike. The cook was a good one and the food plenty and excellent. We had fresh meat twice a week during the winter, and every day in the spring. This consisted of deer, ptarmigan, rabbits, and fish. Most of the deer-meat came from the Notoark valley—twenty-five hundred pounds of it were consumed. There were also eaten eighty ptarmigan and twenty-five rabbits, sixty-seven geese, seventy-six ducks and two sand-hill cranes. The geese, cleaned, weighed from four to six pounds; the ducks, one and a half pounds. Most of the fish were caught just as the river was freezing; as soon as taken out of the water they froze and remained so until used; only a few were caught in traps during the winter. A fish called the "See" by the natives was most appreciated, and the "Coup-tick" came next.

At all meals tea, coffee, milk, sugar, molasses, pickles and condiments were issued to the extent desired. As great a variety as possible was observed in the bills of fare, though about certain eatables a regular daily routine was thought best; thus, every breakfast there were cakes, and butter was used at this meal only. Soft bread—generally rolls or biscuits—was given every night for tea.

It should be remarked that pork and beans held the leading place in the list of relished food; next in order came Philadelphia pepper-pot soup, and among desserts plum-duff with hard sauce surpassed all competition. For drinking, coffee led for the first half the winter. Tea came gradually into favor, however, and by spring it was preferred by all hands. I would advise that some spirits be always carried on similar expeditions; a little given occasionally is undoubtedly beneficial, stimulating the mind as well as the body. I had none with me; but the little alcohol given with the lime-juice did much good.

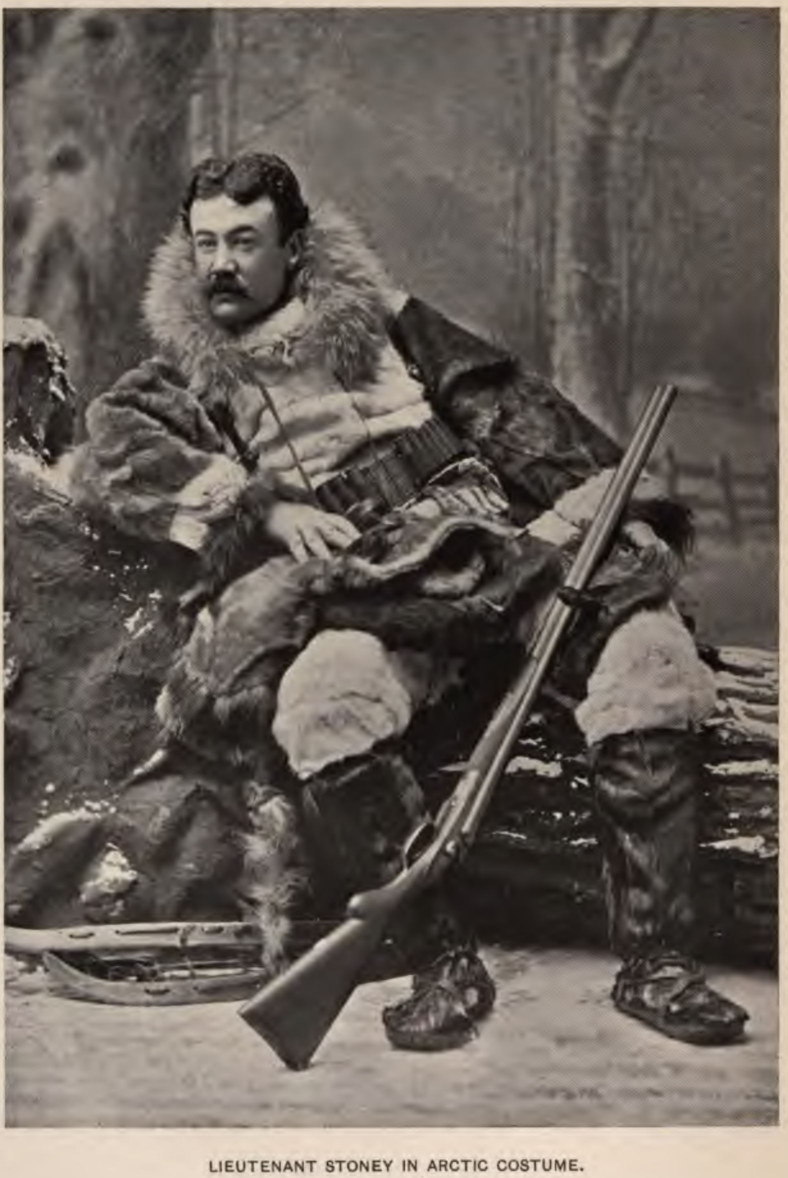
A good cook is indispensable in keeping up health and spirits, and both these are of primary importance on such expeditions. There was never any grumbling about meals, and at the sight and odor of the really excellent food any discontentment of the moment disappeared.

Health and Exercise.—Not one case of sickness occurred. The entire party when in quarters took exercise daily between 9.30 and 11.30 A. M. The officers generally walked, the men cut wood and worked about the fort; the machinist overhauled the engines and the carpenter built sledges, etc. A monthly examination of the party was made by the surgeon and the results reported. Also every month the members of the expedition were weighed. No appreciable change was observed during our entire stay. At first, when the carpenter and machinist were kept at work inside the house it was noticed that they became very pale. Making them leave their benches and go out doors remedied this. The rigid enforcement of these health-rules created the only murmuring during the whole trip.

Amusement.—The spirits of the men were always good and cheerful. Knowing music to be of great assistance, I took with me a tournaphone which proved a source of great pleasure to everybody. To have some musicians among the men of an Arctic party is of importance. It would be well, too, to take a few bright, cheap chromos and some colored globes for the lights to enliven the walls of the quarters. Pictorial papers are a never-ending source of pleasure, no matter how old they may be. My men never tired of looking at them, and a few of the most striking they put up on the walls. Light, sensational novels were relished, also simple histories, stories of travel, geographies and rudimentary works of science. Games of cards, dominoes, checkers, etc., were played often by all hands, and thoroughly enjoyed. Skates made by the machinist afforded a great source of amusement. Expeditions should carry skates, as those made on the ground are not very good.

Society.—The men got on admirably together; there were no fights and no serious quarrels or disagreements. The little annoyances incident to such close companionship were philosophically borne and readily forgiven and forgotten.

Instruction.—Every day an officer instructed the men in whatever branch might be desired. Mathematics was the favorite



LIEUTENANT STONEY IN ARCTIC COSTUME.

study. Nearly all the men took lessons during the beginning of the winter; but the number gradually lessened; only three holding out till spring. An attempt was made to teach Aloka, the interpreter, how to read, but he took so little interest in the work, it was given up.

Punishments.—These consisted in extra watches given to men who had been careless in recording observations, etc. An occasional loud oath or word called for a reprimand. But such misdemeanors, I am glad to say, were surprisingly few.

Clothing.—Beyond question fur clothing is the only kind suitable for Arctic wear, and it should conform in material and cut to that worn by the natives. The members of the expedition wore deerskin coats with hoods (parkies), deerskin trousers, deerskin boots and deerskin socks, over underclothing of flannel. The parkies are shaped like a shirt with a hole in the neck just large enough to admit the head; around the back of the hole the hood is sewed. They are double, the inner skin being light with the fur turned towards the body, while the outer skin is of the heaviest with the hair turned out. The trousers, of heavy deerskin, the hair turned out, were of two styles—like sailors' trousers and like citizens' trousers. In the former style, they were buttoned around the waist, in the latter they were gathered around the waist by a string. I preferred the flap, finding it more convenient; most of the party, however, liked the other. The bottoms of the trousers must always be tucked into the boots. The boots are of deerskin with soles of the same. They should be made with the skin of the deer legs, the toughest part of the hide. The best trousers are also made of this part. The legs of the boots have the hair turned out, while the soles have it turned in. The socks are made of skin with very thick hair, turned in. The party wore woolen socks next the feet, and over these the deerskin socks. A belt should be worn outside of all to tie down the parkie and keep the wind from getting under. An overall of some light material, drilling or calico, same shape and length as the parkie, should always be worn when out on a trip, especially during a snow-storm or drift, to keep the snow out of the hair; for once in, it melts when the parkie is worn in the house, and the garment is ruined. The same rule applies when the deerskin trousers are worn.

While sledging much comfort will be found in putting across the length of the nose a piece of deerskin with the hair turned in. This piece should run far enough back to cover the cheeks, and fasten at the back of the head. Similar pieces should be put across the forehead and chin. The beard on one's face, especially about the mouth, should be worn short on account of the condensation and freezing of the moisture of the breath; but that on the chin and neck should be long, as it is a splendid protection. A skull-cap, fitting close, and coming down over the ears should be used, for only in extreme weather is the hood comfortable. The Elsinore cap of the whalers is as good as the skull-cap and should take its place where it can be had.

Mittens of deerskin, the hair turned in, are the only things that will keep the hands warm. Woolen mits with one finger on them may be worn under the deer-mits, especially when out hunting; but for warmth the deerskin alone is better. The woolen mits stop ventilation when inside the deer-mits and get moist from perspiration which freezes when exposed; in deer-mittens the hair takes this up and the congelation occurs away from the hand. When the deer-mit gets cold it can be turned inside out, and by striking, the ice is knocked off.

The underclothing we used was of thick substantial flannel. Chamois underclothing is the best. I had had them on my first trip. Use large horn buttons on clothes, as small ones are difficult to manage when the weather is very cold.

For summer wear overalls are good. Boots should be of sealskin tanned with the hair off. Straw should be worn inside the boots to protect the feet when walking on stones and rough places. Sealskin boots are water-tight and the only foot-gear suitable for walking on tundra. Other boots lamed all who wore them longer than a day. In the spring, when it is too cold for woolen clothing, outer garments of sealskin are excellent. The skin should be tanned with the hair on and should be worn with the hair out. Melting snow ruins deerskin clothing; besides, in the spring they are too warm. Soles of boots made of deerskin, with the hair inside are excellent for winter use, especially where there is a great deal of walking. Snow-shoes are indispensable; large ones for country use, small ones on the seaboard.

IV.—SUMMARY OF EVENTS AND WORK DONE FROM GOING INTO WINTER QUARTERS UNTIL OUR DEPARTURE.

As soon as we were well settled in our winter quarters, preparations were begun for carrying out the main object of the expedition; that is, the exploration of the Putnam River valley, and the regions adjacent.

The selection of Fort Cosmos as a base for this work proved to be a most happy one. Lying as it did well up to the head of the river, we were able to strike across the several divides into the adjoining river-valleys by comparatively short routes, making the total number of miles traveled by the several expeditions sent out, less than would have been necessary from any other point.

On October 1st, the river became clogged with ice; by the 13th, it was frozen solid for the winter. November 1, the ice was sixteen inches thick, the weather very cold, and we began taking daily exercise and the use of lime-juice. On the 24th, I thought I felt a slight earthquake shock; the other officers noticing it also. It may have been caused by the ground cracking from cold.

December 1st, I left with a party to explore the head waters of the Notoark, the Inland River of Captain Beechey, and the country to the northward, returning on the 18th. Ensign Reed was left in command at Fort Cosmos, with written orders. December 6th, Dr. Nash and party left for the inland trading post of the Yukons to obtain ethnological information. They returned on the 12th, accompanied by some Yukon natives. December 26th, Passed Asst. Engineer Zane and party left for St. Michael's, returning on February 25th, 1886. December 29th, I left with party to explore Selawik Lake and River, returning January 7th, 1886, Ensign Reed being left in command.

On January 20th, I began a series of observations for establishing a base line for the purpose of triangulating the Putnam River valley. February 28th, I left on a trip to explore the head waters of the Putnam, and the country to the northward, from which I returned on April 6th, Ensign Reed being left in command. March 1st, spring routine went into effect. March 10th, Ensign Reed and party left for the "hot spring," leaving Ensign Howard in charge at the Fort, and returning April 2nd.* April

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* Detailed accounts of the several exploring expeditions are given in Chapters VI and X.

12th, Ensign Howard and party left for Issheyuk, where in accordance with arrangements made on my visit in March, he was to join the natives and accompany them to Point Barrow, whence he was to return by sea and meet us at Hotham Inlet.

April 26th, geese were seen flying over and snow-buntings appeared. April 30th, signs of life began to be visible in trees and bushes, and natives began moving from winter-quarters to high land. Discontinued the use of lime-juice. May 3d, floated the Explorer. May 19th, the ice cracked along the banks of the river and began drifting. The main ice in mid-river held a few days longer when great masses broke off and drifted down. May 27th, launched the Helena, put in the boiler and engine and got both boats ready for use. The ice began breaking rapidly. The water in the river would rise a couple of inches in one hour and fall suddenly the next, indicating the forming and breaking of large ice-gorges. May 30th, the whole body of ice started and then jammed, raising the water five inches in fifteen minutes. Then the mass moved lower down. I got steam up in Helena and towed the Explorer three miles up the creek, to be clear of all danger and left a crew in her. Mosquitoes appeared and the grass began to show green.

By June 3d, the river being practically clear of ice, I towed the Explorer down to the Fort, got her ready, and began preparations for leaving. On June 8th, I started down the river with half the party in the Explorer, towing two skin boats, with provisions and leaving Ensign Reed in charge of fort, with orders to continue the preparations for leaving. I returned on June 13th, having established Camp Retreat in the delta, about thirty miles from Pipe-spit. The next day Passed Asst. Engineer Zane, with a party, and the remainder of the stores left in the Helena for Camp Retreat.

June 15th, I moved on board the Explorer, closed the house where the expedition had been quartered for two hundred and sixty-two days, and abandoned Fort Cosmos. I left a record sealed up in a pickle-bottle and buried at the observation spot. It contained the names of the party, and stated that the expedition had lived there from September 25th, 1885 to June 15th, 1886, and that the health of all had been good; that there had been no trouble with the natives, and that on June 15th all hands had started for Hotham Inlet.

On June 17th, having started the party off, I went up to the head of the valley and began in the work of triangulating down the river. I reached Camp Retreat June 25th, having brought the work down to the mouth of the main stream. The next ten days were spent on the work in the delta, when I returned to camp, July 5th. On July 7th all hands left Camp Retreat, and that night pitched tents, unloaded boats, and established ourselves for the time at Camp Purcell, on Pipe-spit. The next day I returned to Camp Retreat and brought the remaining stores down to Camp Purcell.

July 12th, Ensign Reed and party were sent to complete the work in the Notoark River. They were towed about sixty miles up the stream and left to carry explorations up to the point where I had left off in December. They returned on the 22nd. July 16th, I left in Explorer to further explore and survey Selawik Lake and River, Passed Asst. Engineer Zane being left in command at Camp Purcell. We returned on the 24th, having completed the work. On July 20th, Lieut. Hamlet, U. S. R. M., executive officer of the U. S. Revenue Cutter Bear, which had arrived off Cape Blossom, visited Camp Purcell, bringing mail and communications. Passed Asst. Engineer Zane, representing the commanding officer, paid an official visit to the Bear, July 22nd. July 27th, I left with party in Explorer to visit the mountains north of the Putnam River in search of jade-stones, returning on August 7th, having found the jade-stones.

V.—TRAVEL AND TRANSPORTATION—THE BEST ROUTES.

Experience has proven conclusively to me that in Arctic Alaska the surest and best routes for travel lay along the rivers and lakes. Going across the country is seldom practicable. In summer walking over the tundra land is so fatiguing that but little headway can be made. While in winter the snow lies to a depth of from ten to fifteen feet, in many places drifting to a much greater depth. A road has to be broken ahead of the sledges by men on snow-shoes, and the snow is so dry that the least motion in the air will cause it to move and cover your tracks before you can retrace them. Then, too, you encounter brush through which a way is hard to make. Along the rivers and lakes you have the banks to guide you, and where the snow has been blown off, which is often the case, you have a smooth surface to sledge over. In places where the current is strong, however, the ice overrides and makes it very rough, and a road has to be cut through or you must go around. Such places do not occur often.

Dogs.

The dogs of Norton Sound and the Yukon River are superior to all other Arctic country dogs I have seen. Undoubtedly this is because the traders have improved the race by crossing strains and introducing new breeds. Dogs are numerous and easily obtained in summer when only a few are used for tracking. They cost from $3 to $5 apiece in trade articles whose absolute value is only $2 or $3.* In winter dogs are not often for sale, and if purchased, bring exorbitant prices. In choosing a dog, first look at his teeth. These should be well formed, glossy white, and all in place. In old dogs the teeth are discolored and the molars are worn, preventing them from chewing bones and frozen meat, often their only sustenance on long journeys. One of my dogs died of starvation on this account. Between three and six years of age the dog is in his prime. Before this he is rather delicate for hard work; and after his sixth year he begins to fail. In addition to perfect teeth a good draft dog should have a short neck, thick shoulders, broad back, solid legs and large paws, with little hair on them, especially between the toes, since the ice clogs them and causes sore feet; for the same reason the legs should have short hair. He should have a good thick growth of hair on the body to keep out the cold.

Never get sluts for sledging, as they are too tender. There have always been disagreements as to the advantages derived from emasculation. The Touches in Siberia always do, while the Inuits never. Half of my dogs were, and I unhesitatingly pronounce in its favor. The Inuits object to it; it stops breeding and they claim that it also affects their power of endurance. This latter I did not find true; my gelded dogs proved as good, as hardy, as intelligent and less belligerent than the others. And to stop their fighting is a matter of importance for it seemed to me they were always quarreling, except when constantly watched and worked, when some unfortunate is rendered useless for several days. To prevent this they were all kept chained separately. Another advantage of chaining is that the food can be fairly distributed. These dogs are tractable and intelligent. They obey tolerably well through fear and not affection—for there is no affection in any Esquimaux dog's nature. They recognize those who feed and take care of them, and stay where they belong. In selecting dogs get those of moderate weight, seventy-five pounds. Heavy dogs require more feeding, are no better pullers, ,and are clumsier and lazier; then, too, they break through snow-crust where a smaller can safely go.

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* These were the prices paid on my visit. I understand they are much greater now.

Most of my dogs came from Norton Sound. They did not stand the sea-trip well, getting very seasick and vomiting the little food they ate, and they got badly constipated. Their main sustenance was water, and they drank it all the time. Fish was my principal dog-food. It should not be given raw and fresh, for though hunger may drive the dogs to eat it, it makes them vomit. Fresh fish should be roasted or boiled. Boiled food fattens rapidly but makes them soft. A little oil given twice a week is beneficial; it keeps the bowels open; given too often it makes them short-winded and thirsty. Dried fish is the best food; the objection to it is its bulk. This I remedied by cutting up the fish, mixing with oil, and putting it under a pressure of three hundred pounds. The surplus oil was squeezed out and the fish pressed into compact cakes. I would recommend that a cooked meal with oil be occasionally given, especially after several days of hard travel. Such a meal seemed of more service than a day of rest. Cooked deer-meat is passably good, though its effects are often unaccountable, sometimes inducing diarrhœa, and sometimes such painful constipation that the dogs howl. The best of all food if procurable, is pemmican; even with this, a warm meal will be beneficial after heavy work.

They should be fed once a day, an hour after stopping for the night. Give them as much as they wish or as much as the supply will permit. They go to sleep immediately after, and in the morning are in prime condition. Feed only at night, never during the day while traveling, for it makes them lazy. A dog is good for six days' work; then he should be given one day of rest and if possible, give a meal of cooked food. Some claim that a dog is good for ten days, but in this case he must be given more than one day to recuperate. It may be difficult at times to get wood to cook food, but the benefit the dogs receive from a hot meal warrants the trouble. Dogs are tender the first forty-eight hours of a journey; their bowels get loose which makes them weak; they should be worked slowly on first start. The natives claim their dogs sometimes went mad; but in my entire stay I never had a rabid dog. One of my dogs showed sign of rabies, so the natives said, but a pint of seal-oil restored him. This madness is caused principally from constipation. The fact is that even with the native dogs, who get no care, you never hear of a case in summer when animals get grass and more digestible food, and plenty of water. The symptoms of the madness are marked. The dog becomes droopy, his eyes grow glassy, he froths at the mouth, which is soon followed by fits. At the first symptom give the oil. Strange to say, when a dog goes mad, the others will in a body jump on him and actually tear him to pieces.

For transportation sledges drawn by natives or dogs or by both are the most practicable. Reindeer are not desirable, as they have little strength and endurance as compared with the others. The fact that the Siberian natives, who have herds of tame reindeer, use their dogs for transporting their camp outfits, proves the superiority of the latter.

As between the natives and the dogs, the former are to be preferred, as in addition to their intelligence, they can pull nearly three times as much as the latter, and can exist on as little food. Four natives can pull a sledge-load of over one thousand pounds over a comparatively rough country, while it would require at least ten dogs to do the same work. My dogs were the subject of careful investigation; they were carefully weighed before and after trips, their habits were noted, and I fed them myself. It was observed that in the beginning of a trip, each dog lost a pound a day for the first ten days, after which the weight remained steady. On returning from trips, and giving rest and good food, there was a steady gain of one pound per diem until the normal weight was reached.

FOOD FOR THE MEN.

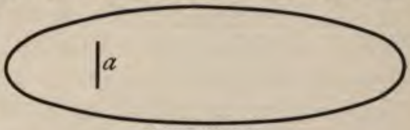
Food of the most condensed and heating character only is recommended for a sledge trip. This should be put up in waterproof packages of a size best adapted for "packing" and stowing on the sledges. Pemmican, I regard as the best food for an

Arctic journey. It is made as follows: The best lean beef without fat or sinew is dried and ground up and then allowed to absorb all the pure beef tallow it will take up. A few currants added make it more palatable. After it, come canned pork and beans, canned soups, jerked beef or venison, sausage (Bologna), pork, lard, canned corned beef, flour, cornmeal, oatmeal, hardbread, sugar, tea, coffee, chocolate, condensed milk, butter, salt, pepper, rice, pulverized potatoes and onions, dried and canned tomatoes, sauer-kraut, olive-oil, flavoring extracts, plum-pudding, raisins, sauces and lime-juice. The kind and quantity of food taken must of course depend on the length of the journey, and the facilities for transporting it.

SLEEPING BAGS.

A sleeping bag for each person is almost indispensable on a sledge journey. It should be made of reindeer skin, with the hair side in, and covered with some light water-proof material. The deerskin is far superior to sheepskin, being much warmer and lighter. Had wool been the best, the Creator would have put it on the reindeer. The same applies to clothing.

In making the bag it should be cut so as to have as little bulk as possible. It should be not over six inches longer than the body, and just so much larger as to allow the occupant to turn freely without turning the bag with him. At *a*, near the head in the figure, is a slit large enough for the occupant to get in feet foremost. The head is then drawn in and the slit laced up from the inside. One might think he would suffocate, thus shut in, for want of air. My experience was that I got too much air. I do not recommend double bags. After the hardships of the day, undisturbed rest is desirable, and this cannot be had with two people in one bag, to say nothing of other disagreeable features.



SLEEPING BAG.

VI.—WINTER EXPLORATIONS—EXPEDITION TO THE UPPER NOTOARK AND HEADWATERS OF THE COLVILLE RIVER TOWARDS POINT BARROW.

On December 1st, 1885, I left Fort Cosmos, with Ensign Howard and four natives, to explore the headwaters of the Notoark or Inland River, and to decide on the practicability of sledging to the northward to Point Barrow. My outfit consisted of three sleds, twenty dogs, rations for twenty-five days and a complete traveling equipment.

The route lay across the tundra on the northern side of the Putnam valley, over to and up the Nut-vuck-to-wo-ark River.* This road is good in early winter; later the snow is drifted into the valleys by the high winds to a great depth. A great objection to this route is that the rapids do not freeze; a thin ice forms over them, which is so deceptive that dogs and sleds break through, necessitating the making of roads along the banks among the growth of low brush; and even here are numerous springs so treacherous that I often went through. Sometimes there is no covering to the fast-flowing water and fordings have to be made; the water is shallow enough, but the dogs have to be pulled in, and one's boots of deer-hide must be changed for others of seal. The dogs suffer from the water freezing on them, and changing boots in an atmosphere of 50° F. below zero is not pleasant.

To cross the thin ice over running water, the natives make a bridge by laying saplings, two and three feet apart, over the crust and covering them with brush, which makes a slippery surface for the sleds. A long line is made fast to the end of the drag-rope and the other end is manned by natives on the other side of the bridge, who haul the dogs on to the bridge; once on, they quickly get over to the strong ice. By these bridges I crossed, with a sled weighing several hundred pounds, over ice so thin that it could not bear the weight of a single dog.

Whenever stops for the night were made, the dogs were chained up and the tent pitched when the weather was bad, otherwise a native camp was constructed, as follows: Selecting the most sheltered spot, a pit is made in the snow about fifteen feet square and six inches deep by stamping it down with the feet. Around this is built a wall about four feet high by laying young spruce trees on top of one another, and cutting off their inside branches on the side you sleep. This wall has two openings or breaks at one end opposite each other, dividing the wall and pit

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* This river I named the "Ambler," in honor of Passed Assistant Surgeon Jas. M. Ambler, U. S. Navy, Medical Officer of the Jeannette Expedition.

GETTING READY FOR TRIP.

into two parts with a through passage way separating them. Along this way, which must always face the wind, a fire is made of dead wood. On one side of the fire, fine boughs are laid down on the snow and on top of them the sleeping gear. Such night camps are recommended; they are easily made and the coldest nights can be comfortably passed in them. The only drawback is the annoyance of getting wood.

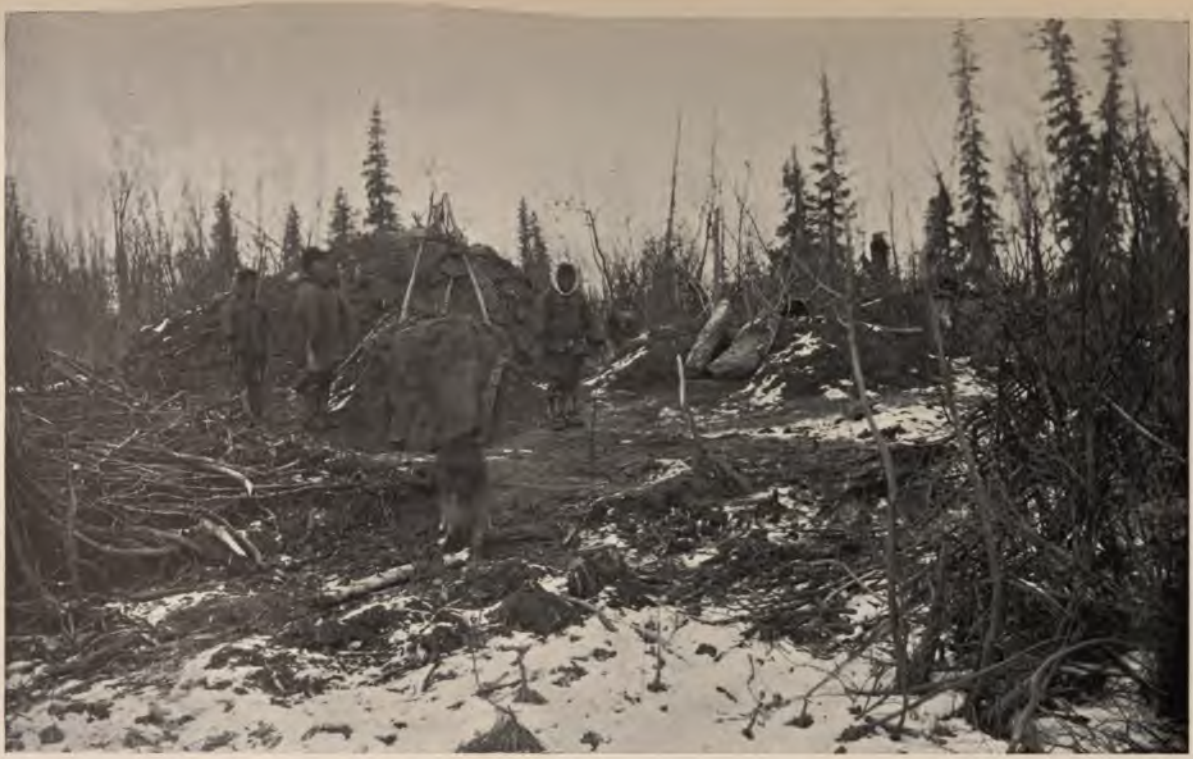
As the return route was to be the same as in going, I cached unnecessary provisions and decided to depend principally on the country; a hole eighteen inches deep was dug in the ground where the fire had thawed it; this was lined with spruce boughs, the provisions put in and covered with more spruce, over this dirt was thrown, then the ashes of the fire, and the whole was covered with snow. The heat melting the snow wets the ashes and dirt and they freeze solid. The reasons for such careful stowage is to keep out the wolves; they dislike ashes and find it hard work to get through them and the frozen ground. The dirt freezes so hard that oftentimes it has to be thawed by building fires on it. The natives when using this route, take only a few provisions; they stop and hunt, and lie over to enjoy the feasts. The food not eaten is cached.

After reaching the headwaters of the Nut-vuck-to-we-ark it was necessary to climb up a smooth snow-hill to reach the divide. Sleds were unloaded and everything carried up. The white men found this very difficult, having to cut footholds in the snow; but the natives scaled the hill with ease. From the top of this divide the view was superb; high mountains, deep gorges, rolling valleys, rivers, cataracts, frozen waterfalls, met the eye continually.

On December 9th, I reached Nimyuk (Cotton-wood), the highest settlement on the Notoark River. The village consisted of four huts and thirty inhabitants, subsisting almost exclusively on deer-meat of which they had at least two thousand pounds on hand. The day of my arrival they killed thirteen deer; and in some of the caches were as many as thirty. I was considerably annoyed by the curiosity of these people and by their superstitions. As it was their dancing season, no meat could be cut with an axe, so I was compelled to saw up a frozen deer—a difficult task. Neither could any meat be cooked in a house nor any tea drawn; it had to be done outside and passed in through the chimney-hole. These fancies are persisted in because they think that to do otherwise would drive the deer from the mountains. In most places these habits could be overcome by paying, but I met with no success at Nimyuk though offering tempting inducements.

From Nimyuk I stood to the northward and eastward, following one of the branches of the Notoark to its source in the mountains, then over the dividing ridge where I struck the headwaters of the Colville River, down which I traveled several miles, coming to Issheyuk, a village of fifteen huts, situated near the northern limit of the mountain range. Approaching the settlement, I was stopped by some natives who demanded tribute; my natives becoming terrified, advised compliance. Suspecting foul play, I told them I would consider their request when the village was reached, and so proceeded on, and soon learned that my supposed ignorance of their ways had induced some scamps to attempt to impose on me. Their failure was laughed at by the body of natives at the village, where several hundred of them were gathered from all parts of the Notoark and surrounding country to have a big dance. This large body of natives surrounded us, the men beating tom-toms and the women singing, and for a time we felt anxious; but, their ceremonies over, they gave the hand of friendship and extended the freedom of their village. I remained one day at Issheyuk and learned that some of the natives went to Point Barrow every summer. This information was verified by the army blankets, army overcoats, and army buttons which they had, and which they said, they got from white men at Point Barrow, evidently the party of Lieut. Ray, U. S. A. I offered every inducement to be taken to Point Barrow, but without success, for they declared that to go at such a time would result in starvation. However, they offered to take me next spring. Not having enough provisions to last until then, I decided to return to Fort Cosmos and to try more to the eastward. Before leaving I made arrangements with the most influential man, Oupuk, to send a party with him to Point Barrow in the spring in case I could find no better route to the eastward. So on December 12th, I left for home, following the same route, and arrived at Fort Cosmos, December 19th.

At Nimyuk, at the headwaters of the Notoark, the natives live in hemispherically shaped huts similar to those of the Putnam; they have two ice windows on either side the entrance and a meat-



NATIVE HUTS, PUTNAM VALLEY.

stand opposite. On this meat-stand at the back of the hut and opposite the entrance, several hundred pounds of deer-meat are always kept, so that a quantity will be on hand sufficiently thawed for use. As soon as I entered, some of this partially thawed meat was handed me on a tray. Meat is never cooked but once a day, in the evening before turning in. About 5 P. M. a large fire is started and the pots full of meat are put on. These pots, the ordinary boiling pots of civilization, they get in trade: in their absence pots made of clay from the Selawik River are used. The cooking is done by the women who taste the meal from the moment it is put on the fire until it is thoroughly cooked; then the fire is dexterously thrown out through the chimney hole in the roof, by young men using long sticks as tongs. When the hut is clear of smoke, the flap that covers the chimney is hauled over for the night, and all hands go to sleep. When the hunters return from a trip they are given a hot meal. Upon entering the hut they take off most of their clothes and their wives and daughters hang them up. Then they fall to, eating pounds of the boiled deer-meat and drinking gallons of the soup; a pipe is next enjoyed, and then all hands turn in for the night. All the household are fond of stripping and baking themselves before the fire, particularly the old people who go so close as to almost blister their skins; they say the heat makes them young and drives away their pains.

EXPEDITION TO SELAWIK RIVER.

On December 29th, 1885, I left Fort Cosmos with three natives, two sleds, sixteen dogs, and provisions and outfit for ten days. My object was to explore the country between the Putnam River and Selawik Lake, and to see if there was a Selawik River. The route followed led across the southern side of the Putnam valley, through a pass over a ridge of hills, 400 feet high, into the Selawik valley. The country was rolling tundra land, generally bare, with a scant growth on the banks of the small streams and around the lakes. Finding a Selawik River, I traced its course for many miles. I cut through the ice and found no appreciable current, but water deep enough to float the Explorer when the river broke. A range of mountains 2000 to 3000 feet high, running in spurs with high hills between, makes the watershed between the Putnam and Selawik Rivers. The natives of the

Selawik are miserably poor and badly clad. They get little meat, as few deer are found in the neighboring mountains; so their main food is fish and the berries they gather in autumn. Their habits and customs are like those of the Putnam natives. The journey was particularly hard because of the cold weather, the thermometer ranging between — 60° and — 70° F.; and also because only a little wood was procurable for making fires. The dogs suffered terribly, their feet cracking open and bleeding with every step. I was compelled to employ natives to drag the sleds where the roads were heavy. I reached Fort Cosmos after an absence of ten days with some of the dogs so far gone they had to be carried. This trip was of much service in that it showed me the nature of the work to be undertaken by the Explorer when the Selawik River opened.

Expedition to the Northeast toward Point Barrow.

On February 28, 1886, I left Fort Cosmos to explore the headwaters of the Putnam and the rivers and country to the northward, and also, if practicable, to reach Point Barrow. I took with me two natives, the interpreter, three sleds, nineteen dogs, and outfit and provisions for twenty days. The route lay up the Putnam. At Kallamute one of my natives refused to go on until the day following, and all the inhabitants of the village sustained him, so I left without him. However, by noon he overtook me, saying his wife insisted on his going.

Before reaching Par Village a messenger from Saulogs, the most influential native of the Putnam, informed me I could travel no further without paying tribute. My answer was that I would make no payment and that I would keep on. As I drew nearer the village his mother came out and ran ahead of my sled, refusing to notice me or answer my questions. A still worse sign of displeasure and anger was that the inhabitants kept in their houses instead of coming out to greet me. Arriving in the village, Saulogs sent for me; I not only refused to go to him myself, but also forbade my interpreter's going. My entire disregard of Saulog's presumption, and the position I took, that I was the greater "Oumalik" or chief, resulted most beneficially, though probably I was more concerned about the outcome of the matter than he was, being the only white man in my party. I carried my point and he sent his wife to hold a council of peace, which terminated amicably and I proceeded as I desired.

The journey up the Putnam was one of unusual hardship. The weather was most of the time wretched, and the trails so bad that a way had to be tramped down so that dogs and sleds could get along. The drifts were extensive, and so deep as to sometimes cover the dogs so that they could not move. Nor was traveling on the ice much better; open water was met often, and sometimes we got in. Occasionally thin ice was crossed by laying brush on it; once in a while a bridge of logs was necessary, and at length all travel was stopped and I had to wait for the way to freeze hard. This state of affairs lasted all the way up to the headwaters.

After reaching the headwaters of the Putnam I crossed to the northward over a pass of gradual ascent for two miles, then down a half-mile to a branch of the Al-lash-ook River, a tributary of the Koyukuk or Ting-ga-rag-a-wick, rising at the foot of the pass. The pass was covered with a scrub growth of spruce. From the highest elevation, 800 feet above the Putnam, I could trace for miles the headwaters of the [illegible], another tributary of the Koyukuk or Ting-ga-rag-a-wick River. But a few miles were traveled on the tributary of the Al-lash-ook, a narrow winding stream, wooded like the Putnam, shut in by mountains, when another pass two and a half miles long was crossed on a N.N.E. course. Then our road led, partly over a chain of long narrow lakes, to the Al-lash-ook River.

The same hard traveling was found on the Al-lash-ook increased by worse weather, and one day a regular arctic gale was encountered. The snow was so deep at times that we sank to our waists and had to plow along to get out.

The Al-lash-ook River is a long stream running along the eastern side of the range of mountains that form the head of the valley of the Putnam. It has its origin in the mountains to the northward and discharges into the Koyukuk River to the southward and eastward, and this in turn empties into the Yukon River near Nulato. Only a portion of the Al-lash-ook was explored by me, as indicated by sledging track on chart. The valley of the Al-lash-ook where I met it, is from four to six miles wide, between mountain chains 3000 to 3500 feet high, with the river running through the center, its width varying from fifty to two hundred and fifty yards. It is shallow and filled with boulders about which a strong current runs. The growth and physical features are similar to the Putnam.

There are many lakes in the valley and mountains. Lake Ta-kahoela is the largest visited. It is eight miles long, one to one and a half miles wide and very deep; the main axis runs N.N.W. It is entirely surrounded by mountains excepting a narrow defile through which a winding stream runs to the Al-lash-ook. The water of the lake is clear, the bottom at a depth of five fathoms being plainly seen through the six feet of ice on the surface; the northern end is deeper. I saw shells on the bottom, but could see no fish, though the guide said they were plentiful. Ten miles up the Al-lash-ook to the northward and westward, the A-koo-loo-ik River enters the left bank. Still higher up at the bend in the river, the Ping-ing-a-look River comes in on the left bank. At this point the valley narrows to less than two miles and is well wooded; the mountains are nearly bare and steep, with numerous waterfalls running down to the swift and tortuous river here only thirty yards wide.

About five miles beyond, the Koo-to-ark River comes in from the northward and eastward. The configuration of the surrounding heights at this junction is worthy of note. They appear in every conceivable way and shape; there are rugged, weather-scarred peaks, lofty minarets, cathedral spires, high towers and rounded domes; with circular knobs, flat tops, sharp edges, serrated ridges and smooth backbones. These fantastic shapes form the summits of bare, perpendicular mountains.

The Al-lash-ook was followed to a fork near its head and then the Koo-to-ark, a small branch on the left bank, was taken, and followed to its headwaters. The Koo-to-ark River at its junction with the Al-lash-ook is thirty yards wide. It flows from the northward in a tolerably straight course. Coming close down to the water are dome-shaped mountains 3000 feet high, for the most part bare, with here and there little patches of soil with a scant growth. Twenty miles up the Koo-to-ark even this growth practically ceases, excepting at long intervals, when a few poor cottonwoods and willows are found. At one of these spots near the headwaters is the small village of Nimyuk (cottonwood), well up in the mountains. It is a stopping place for deer-hunters and traveling parties.

After thirty-five miles on the Koo-to-ark, I crossed the mountains to northward and eastward over a pass 1070 feet higher than the Koo-to-ark, and came to the village of My-og-arg-a-look. Twelve miles beyond, to the northeast, we came to O-co-mon-e-look after crossing a pass 1000 feet higher than the previous one. The road then lay in the gorges over small streams filled with boulders and snow. When ten miles northeast from O-co-mon-e-look, I crossed another pass, unmistakably the work of a glacier, and reached a chain of lakes and the limit of the mountains.

The largest lake, which I named Lake Chandler, after the Hon. Secretary of the Navy, lies between two regular mountain chains, which rise 1050 feet above its level. The shape is regular, running ten miles in length, N.N.E. ½ E., and from one mile to 1000 yards in width, and it is so deep that no bottom can be seen. The lake was frozen with ice five feet three inches thick. There is no growth about the shores nor on the mountains. The lakes undoubtedly are supplied with water from springs; the numerous air-holes and cracks indicated this, as well as the bubbling appearance of the water. I was told that this lake rarely froze over completely, ordinarily a strip of water six feet wide remained open all winter. This part of the journey was still harder because of the scarcity of fuel and consequent sameness of food, frozen deer-meat.

When at the head of the last lake I felt the actual need of some warm food and drink. No fuel could be procured, and my alcohol being out, I purchased a sledge for fuel so that some meat could be cooked and tea made. When the former owner of the sledge saw the labor of so many days' hard work being burnt, aroused by his superstitious fears, he became very much incensed. I was afraid for awhile I would have very serious trouble, which indeed, was only prevented by being very positive with the native, saying it was my sledge, and that I could do as I pleased with it.

I reached the lake on March 18, and learned that there were no natives beyond this point until the coast was reached. I again endeavored to get the natives here to go with me to the Point Barrow coast, but they refused, saying, however, that later, when the rivers that flowed to the northward broke, they would take me. Seeing the impracticability of going any further at this time, I decided on returning as quickly as possible, in order to send an officer with these people, some of whom went to the Arctic Ocean every spring. So arrangements were made with them for taking a party later on.

The way back was over the same roads and in pretty much the same weather, with the advantage, however, of its being down hill, allowing better time to be made. Down some of the steep inclines the sleds went so fast as to be entirely unmanageable, overrunning the dogs and piling them up in seemingly inextricable tangles, and, to add to the difficulties, the sleds often capsized, throwing us in every direction. However, no one was hurt, and finally all arrived at Fort Cosmos on April 6, having slept out thirty-eight nights and being for twenty-four days dependent on the country for food. Lowest temperature 48° below zero F.; highest temperature 28° F.

Su-look-pow-wick is the highest settlement on the Putnam. No other settlements were met until I made the headwaters of the Koo-to-ark, where, at Nimyuk, were two huts inhabited by three men, two women and some children. Between this place (Nimyuk) and the lakes, small villages were scattered all along the way, and at the lakes there was quite a large settlement. All these natives living in the mountains are very ignorant, a great many of whom had never seen a white man before. Only a few go to the Arctic to trade, the majority continue in the mountains, living almost entirely on deer-meat. Some of the Putnam River natives pay them annual visits to trade and kill deer; coming from the Putnam in February. The younger people hunt the deer during their stay and all return in April and May. Their movements are slow, because they depend entirely on the country for food, and stop whenever they encounter herds of deer. The route used by them to and from the Putnam is the one I followed.

While traveling on the Koo-to-ark, I met a party of Putnam River natives en route to the mountains. This party numbered forty souls, and had fifty dogs and twelve sleds. Some of these people presented a rather singular appearance, their sleds being drawn by men, women and dogs all hitched up together. A woman with a child on her back and a single dog with three or four puppies playing beside it would drag a sled, while the man behind pushed and guided, yelling at the single dog as lustily as though his team comprised a dozen or more. Some of them accompanied me for awhile, but left to get deer when the heavy weather came on.

The people in the mountains make their huts by plaiting mountain willow to form a frame, which is held up by a few uprights; on the former they put turf and reindeer moss and then cover with snow. The shape is irregular, generally long, low and narrow. Several families occupy a hut, each having its own ice-cake window, smoke-hole, and fireplace. Alongside the doors at the ends there are ice windows. The natives huddle close together under these low roofs that do not admit of standing, and eat and sleep with satisfaction if not with comfort. A special hut was made for me by bending poles to the required shape and covering them with deer skins, leaving an entrance. Over this mould snow was thrown, which froze solid and made a comfortable house. Upon leaving such a hut the poles and skins are taken down, leaving the snow house. This sort of dwelling is often seen along the line of travel in the mountains and affords good shelter in bad weather.

The houses of the natives living on the lakes are generally circular, with curved roofs, made of plaited willow covered with moss and snow, upheld by three or four stanchions six feet long. The smoke-hole is covered with a cake of ice; also the surface entrance to the passage; their scant fuel is from fat and grease. These huts get completely buried by the heavy snowdrifts. I came upon one village of six huts without suspecting their presence. The winds are so severe that snow shelters have to be built for the dogs. At the observation spot on the lakes I left a cairn containing a pepper-bottle in which was a paper stating that I had been there and who composed my party. In order to impress the natives with the sacredness of the cairn, and that it must never be molested by any but a white man, I performed a variety of antics; and Bill, my dog-driver, told them, with much seriousness, that any one who touched the cairn would have his hand rot off, and whoever looked into it would be struck blind.

Expedition to the Hot Springs.

On March 10, 1886, Ensign Reed, with the sailmaker's mate and two natives, left Fort Cosmos with two weeks' outfit, two sleds, and nine dogs, to visit some reported hot springs. The route lay up the Putnam River for ninety miles, then to the An-ne-lag-ag-ge-rack River, and up it to the springs in the mountains at the head of the valley. There was but one hot spring there, a pool twenty feet in circumference and two feet deep, full of water, of blood-warm temperature that wells up quietly from the bottom without bubbles or disturbances of any kind and fills the pool with a clear, tasteless, odorless water; the overflow runs out, and fills smaller pools lying lower down the mountain side. The bottoms of all the pools are covered with green moss, on which is a lime-like deposit, and the ground and rocks about the pools are similarly coated. About the edges of the main spring were thousands of small snails. The atmosphere is not affected in temperature, nor are the rocks and ground about. The natives say the temperature of the spring varies: that sometimes it is so hot they can cook meat in it. Mr. Reed was seven days reaching the spring and five days returning. During his entire journey the weather was excessively severe, and the traveling particularly difficult. The highest temperature noted was 12° F., the lowest, —42° F. Gales of wind and snow storms were continually encountered, and much of the road through snow had to be tramped out to make it passable. On March 21, the party returned to Fort Cosmos. The distance traveled was one hundred and fifty miles, which was made in fifty-seven and one-half hours (the time actually under way); the speed was 21.4 miles per day of 8.2 hours, or 2.6 miles an hour.

VII.—The Kubuck or Putnam River.

The large river which I named "the Putnam" on my first visit was called by the natives Ku-buck, signifying "big river." It rises high up in the mountains to the east near the 154th meridian and flows with a general direction of W. by S. into Hotham Inlet through some thirteen mouths. The head of the delta thus formed is some forty-five miles from the coast and it has a frontage on the inlet of about thirty miles.

The Putnam lies in a fine valley of diversified country varying in width from six to twenty miles. On the banks of the river and its tributaries there is a rank growth of either spruce, willow, birch, alder or cottonwood extending back for a half a mile; here and there, mixed bunches of all these woods are formed. Back of the growth is rolling tundra land with hills from 100 to 400 feet high, interspersed with numerous lakes and ponds, generally oval in shape, from three to five miles long, and from three feet to three fathoms deep. There is always a scant growth about them, and in the lower parts of the valley blue-flags and daisies are abundant. The tundra has a growth of grass, some of it resembling wheat and wild oats, reindeer moss, whortle and salmon-berries, flowers, including the wild rose, and occasional patches of scrub bushes. On the river banks wild onions grow profusely, which are especially palatable in the early spring. Trees in some locality extend up the mountainsides to a height of 500 and 1000 feet. Although only in spots on the tundra, the growth of everything is luxuriant for so short a season—June to September.

The country of the delta is flat with an occasional low hill, and numerous lakes and lagoons, with marshes of various sizes, all connected by small streams running in every direction and communicating with the several arms leading to the main stream. Most of these delta channels are too intricate to be followed. Of the thirteen mouths to the river, the smallest and shoalest, with a mud flat at the entrance, empties into Selawik Lake; all the others empty into Hotham Inlet and have mud bars with very narrow channels from three to fourteen feet deep at their mouths. The entrance off Nimyuk sand-spit is the widest and carries two fathoms over the bar, but it soon grows narrow and winding. The main entrance and that most easily navigated lies about one mile west of Selawik Lake sand-spit; it is about fifty yards wide with a twenty-yard channel carrying two fathoms over the bar. After crossing, the entrance widens and deepens, and seven miles above the bar is eleven hundred yards wide, with five fathoms of water in mid-stream.

The width of the Putnam varies from twelve hundred yards to fifty yards, according to the nature of the country; when the valley is broad and the mountains well back the river widens and has many islands, some of them quite large; but as the mountains close in, the river narrows and grows winding; and towards the headwaters it twists and turns, finally becoming a narrow, sinuous mountain stream. Traces in the valley and the many lakes show that the river has often changed its course.

The strength of the current is variable, less at the lowest waters and the widest places than at the narrow bends, and higher up where it attains, around the curves, a velocity of three and five knots; while still higher, rapids and rushing torrents are met.

The banks of the river sometimes rise from the water's edge so gradually as to be barely noticeable; in other places there are foot-hills 150 feet high; while in some parts there is a greater height, of bare perpendicular rock. In two places on the left bank are ice cliffs resembling immense frozen sheets of water, on top of which are six inches of soil with a scant growth of spruce and willow.

Where the banks are highest, the back country is most rolling, with a scant growth of spruce and scrub, but an abundance of whortle, salmon and blueberries and reindeer moss. These high banks are sometimes rocky and sometimes of different kinds of clay. Usually a narrow beach of sand or gravel makes out from them. Low banks have wider sand beaches, and in some places there is no beach at all. Near the headwaters, where the river runs close to the mountains, the banks are nearly perpendicular; and a geological formation of slate with quartz, in strata inclined at an angle of about 45°, is easily seen.

About two hundred and fifty miles up, boulders are seen on the banks, becoming more and more numerous as one goes up, until, at a distance of three hundred miles, they are found in mid-stream with the water swirling about them; thirty miles higher they become very numerous and dangerous. About forty-five miles up the river, sand-banks first make their appearance, gradually increasing in number and extent towards the source. Some of these stand well out of water, deflecting the channel to one side or the other. The depth of the Putnam River is quite regular with deep holes here and there its entire length. Beginning at four and a half fathoms, it gradually shoals to one fathom near the Par, three hundred miles up and then grows less. A slight tidal influence was noticeable the first forty miles of ascent, none higher up. The current always sets out.

The mountains are in ranges, groups and semi-detached groups of every shape, indicating their formation at different times and under different circumstances. This range is an upheaval, while its neighbor is a compression; some are well-defined, with round surfaces and a thick growth; others are rugged, scarred and bare. The range on the south side of the valley is the lower, and is in scattered groups, connected by chains of hills, which grow into and form a regular chain of mountains as the valley is ascended. On the northern side the line of mountains is nearly continuous, with many streams running down the valleys to join the main river; on the southern side these streams are noticeably few until many miles up from the mouth.

About one hundred and sixty miles above the mouth, the Ambler, or Nut-vuck-to-wo-ark River, the largest tributary, enters the right bank. It rises in the mountains separating the valleys of the Putnam and Notoark, and is for many miles a rapid mountain stream, winding down in a southerly direction through a valley of its own. Where the valley narrows, the banks rise into towering perpendicular cliffs, and the waters tumble and roar over great boulders. The southerly course is held until within twenty miles of the Putnam, when, the valley opening, the stream turns sharply and runs parallel to the recipient, separated from it by a low range of mountains. By another sharp turn it enters the Putnam at right angles. The valley of the Ambler River is well wooded with spruce, willow, birch and cottonwood, extending well up the mountainsides. The route by this valley is one of the ways of communication between the Notoark and Putnam countries.

About three hundred miles up the Putnam the first large and important tributary from the southward comes in. Its name is "Par," meaning door, because it is the route that leads into the Yukon country. It is a tortuous stream of one hundred miles in length, rising in the mountains to the southward, and running its last forty miles at right angles to the recipient.

Above the Par River many tributaries enter at right angles to the Putnam, but they are too small for any extended navigation beyond their mouths. About ten miles above the Par, the Su-look-pow-vuck-to-ark River enters from the north. It is the outlet of Lake Selby. The native village at its mouth is known as Su-look-pow-wick on account of the quantities of small fish of the same name that are caught here. About thirty miles above the Par, the An-ne-la-gag-ge-rack River comes in from the north by a mouth one hundred yards wide. A high, densely wooded bluff marks the left side of the mouth, and a low, sparsely wooded one, the right. From its source the river runs in a general south-easterly direction for sixty miles through a narrow valley of high mountain ranges ending a few miles above the mouth. Its windings are many and in all directions though of no great length. At the head the valley narrows to one-half a mile with the mountains beyond in which lie the hot springs described elsewhere.

Above the An-ne-la-gag-ge-rack River, the Putnam valley narrows, and the river gets more winding and full of boulders, and the banks are high. The growth is thick, particularly the spruce, which in these higher lands has smoother bark and softer leaves. The mountains are in ridges from 1200 to 2800 feet high and wooded to an altitude of 1000 feet. Proceeding, the river narrows to thirty yards, making the first rapids through a cut in a cross-hill whereon the growth is scant. Going on up, the river widens and the same growth appears as before, meeting the narrows. A curious phenomenon hereabouts is the spruce growing in and out among the rocks with its roots above ground. Still higher, the second rapids are met rushing in a fifty-foot cut through a hill, over and around huge boulders. Above the second rapids the valley opens to ten miles in width; the mountain chain, 2500 feet high on the right hand, and nearer groups 1600 feet high on the left, swing into the high range running northwest and southeast and form the head of the Putnam valley. Among these high mountains, many little streams rise, and, flowing down, meet in the valley to form the Putnam River.

The Putnam River freezes in October and opens in June. The following account is from the observations made at Fort Cosmos. On September 13, ice made on the lakes; on September 23, on the creeks; and on September 25, along the banks of the river and at the headwaters, and drifted down occasionally, jamming and then passing on. By October 18, the river was frozen solid. On the first of each month the thickness of the ice was measured to ascertain the amount made during the month and also the total thickness; and there was a hole kept open to find out the amount made in twenty-four hours. The greatest thickness measured for the winter was five feet eleven inches; in the month of February, five feet four inches made; the maximum thickness made in twenty-four hours was four inches, the minimum one-half inch. The current under the ice was measured and the greatest speed found was 1.6 knots, the least .9 knots. The water under the ice rose and fell all the season, varying from one inch to two and a half inches a day.

The breaking up of the river was interesting. It began at the headwaters by the water forcing its way through cracks and flowing over the ice for miles. At Fort Cosmos on April 29, the ice suddenly became covered with water a foot deep, increasing on both sides of the river and decreasing towards the middle. On May 19 the ice cracked along both banks and the main body in mid-stream rose to the surface, then the ice along the banks began breaking away and rising to the surface. After May 20, large pieces broke from the sides of the main pack and, flowing down, left channels near both banks; the water would now rise and fall one inch to three inches an hour, caused by jams above and below. This lasted until May 30, when the whole mass moved two hundred yards and then jammed, causing the river to rise five inches in fifteen minutes. It then moved lower down and jammed again, and so continued all day, the water rising when the ice stopped and falling when it moved. June 1 the ice moved all day, sometimes filling the river with large cakes and sometimes leaving it nearly clear.

On June 6, the river was clear. The ice on the smaller creeks did not break. They were frozen solid to the ground and the water flowed over the ice which by degrees melted away from the top. With the last of the ice came a large amount of driftwood and some large trees. Though the river was clear by June 6, the ice remained in Hotham Inlet as late as July 8.

LAKES.

The principal lakes connected with the Putnam River are Lake Selby, Now-tow-vuck-toy, and Lake Walker (Kal-lu-look-to-ark), on the northern side of the river, and Lake Now-get-to-ark on the southern. Lake Selby is of glacial origin, shown by the peculiar formation of the banks and islands. It lies between two mountains 2000 and 3000 feet high, is five miles long and three broad, of an oval shape, and quite deep, in places no bottom at eighteen fathoms. The long axis is north and south. There are two islands near the lower end. The water is fresh and said to abound in a species of salmon. The outlet to the Putnam is the Su-look-pow-vuck-to-ark River. Lake Now-tow-vuck-toy is quite similar. It is eight miles long, bare of islands, and its major axis is nearly parallel to the Putnam. Its outlet has the same name. Lake Walker, Kal-lu-look-to-ark, or "Big Fish," lies in a valley among mountains 3000 and 3600 feet high and is surrounded by hills 150 to 350 feet high. The length is fourteen miles, running northwest and southeast, and the width three to six miles. In the center of this lake, and near one another, are three small rocky islands. Fish abound. The outlet is a small stream, entering the Putnam. On the southern side of the Putnam valley is Now-get-to-ark Lake (Gull Lake), a round lake of four miles diameter. It is the breeding place of the gulls; millions of them nest on its shores. The outlet enters the Putnam at the first narrows. The above lakes lie well up from the sea. In the lower part of the valley they are more numerous, and of all sizes, shapes and depths. They lie scattered about between the foothills of the tundra, often connected, making chains of lakes and ponds, some with no visible outlets, and others with rivulets running to the Putnam. Here and there all through the valley are little springs of good fresh mountain water. There is only one hot or warm spring.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE SIGHTING OF CERVERA'S SHIPS.

By Lieutenant Victor Blue, U. S. Navy,
Of the U. S. S. Suwanee.

Sunday morning, June 5th, the U. S. S. Suwanee, Lieut-Comd'r Delehanty, joined Admiral Sampson's fleet off Santiago. She had on board arms, ammunition, and supplies which had been taken from the transport Gussie, and which were to be delivered to the insurgent army on the south side of the island of Cuba.

Captain Delehanty immediately opened communication with a part of the insurgent army under Colonel Cebreco, operating near Pt. Cocal, and with the main body under General Cebreco, whose headquarters were near Aceraderos, nineteen miles west of the entrance of Santiago Bay. The location of Pt. Cocal and of Aceraderos may be more readily fixed in mind when it is remembered that they are marked by the wrecks of the Maria Teresa and the Viscaya respectively.

After passing the night on her blockading station off Santiago, the Suwanee would go to one or the other of these places and remain for the day, while her boats were engaged in landing supplies for the insurgents. Thus her officers became well acquainted with the Cubans and familiar with the localities where their camps were situated.

On the morning of the 10th, one of the auxiliary vessels coming from the flagship hailed the Suwanee through the megaphone and said that the Admiral directed us to communicate with the insurgents at once and ascertain positively before night whether or not all of Cervera's ships were in the harbor. Immediately the Suwanee was headed for Aceraderos; and on the way to that place Captain Delehanty talked the matter over with me. His idea was that, in order to obtain reliable information, an officer should make the trip, accompanied by a Cuban guide, to some point where a clear view of the bay could be obtained. The intention was to pick up a guide at Aceraderos and return to Point Cocal, where the officer and guide would be landed. It was thought that they could climb one of the high hills in that vicinity, view the harbor, and return on board in time for the Suwanee to reach the flagship off Santiago before nightfall. This plan semed very feasible, with little or no danger attached to it, and it was with a light heart that I set out for General Cebreco's headquarters to procure a guide, all the while entertaining pleasant anticipations of seeing that day the wonderful squadron of Cervera's, about which so much had been said and written. General Rabi, who had arrived the day before, being senior to Cebreco, was found to be in command. He received me very kindly and courteously, and after hearing my plan, replied at once that it was impossible; because, as he said, the Spaniards had only the day before driven the Cubans back from Point Cocal, and were probably at that moment half way between that point and Aceraderos.

After a consultation with Cebreco and several scouts who had recently come into camp, he informed me that there was a place to the northward of Santiago where it was possible to go through the enemy's lines and approach near enough to the bay to obtain an unobstructed view of it. "But," he said, "you cannot make the trip in less than two or three days; a Cuban can make it in two by riding night and day." There being no ostensible reason why an American should take a longer time than a Cuban to make the trip, Rabi's plans were accepted, a note was sent by the coxswain of the boat to Captain Delehanty, apprising him of the changed conditions of affairs and informing him that I should return in two days' time. Preparations were at once begun for the journey. Rabi's mule, the largest at the camp, was made ready for me. By this time many officers had grouped themselves around the general's tent and seemed to take much interest in the proceedings. A suitable guide had to be found, and a number of officers volunteered their services. Major Francisco H. Masaba-y-Reyes was selected, and no better man for the work in hand could possibly have been found. In appearance he was a dark mulatto, with bushy black hair and whiskers, keen black eyes and fierce countenance. His gruff voice was seldom heard except in monosyllabic oaths at his mule when this unfortunate animal would reach for a blade of grass along the road. He was not a person that one would select on short acquaintance for a traveling companion on a pleasure trip through a lawless and lonely country.

As we were on the point of starting, the Suwanee fired a gun and hoisted a flag at the fore. This was the pre-arranged signal for me to return. I assumed that the captain wished to acquaint the Admiral with the unexpected condition of things before allowing me to proceed, and therefore asked General Rabi to have everything in readiness for the journey the following morning. When I returned on board, the Suwanee steamed back to the fleet. Captain Delehanty went on board the flagship and came back with the order for me to proceed. So the next morning found Masaba and me steering a course for the hills back of Santiago.

The Cubans had disapproved of my wearing uniform as, they said, there was no chance of success if we were seen and recognized by the Spanish troops, and that if we were seen at a distance the uniform would cause them to recognize us at once; whereas, if my costume was that of a Cuban they would mistake us for "pacificos" unless we actually fell into their hands. The Cubans contended that there must be "catching before hanging," while I preferred to run the risk of dodging a few Mauser bullets from poor marksmen rather than the certainty of a halter if we were captured.

From Aceraderos our route ran four or five miles in the direction of Point Cocal in a mule path cut through an almost impenetrable jungle that covered the slope between the mountains and the sea, then to the northward we followed the course of a mountain stream that was the dividing line between the insurgents and the Spaniards. The journey through the jungle and over the mountain range was without incident, except for a few interesting moments passed in ascertaining whether an occasional challenge that rang out sharply from some hidden retreat came from a friend or an enemy; for, as this was neutral ground, there was a possibility of encountering Spanish pickets. On occasions of this kind, however, the suspense was only momentary, as after a few minutes' parley at a distance we always found our challengers to be Cubans. In order to show the difference between the Spanish and the Cuban methods of warfare, it may be mentioned here that during the entire trip of seventy miles not one Spanish picket was seen, notwithstanding the fact that Spanish troops in considerable numbers were occasionally passed. The Cubans, on the other hand, were always on the alert, and not once in the many times we passed in and out of their lines did their vigilant pickets fail to challenge us.

While descending the northern slope of the mountains we obtained our first view of the Spaniards. Masaba, who was riding ahead, suddenly spurred his mule into a run and motioned me to do likewise. It did not take many seconds for me to understand this action of Masaba's; for glancing to the right I saw a Spanish camp on the hillside about six hundred yards away. The soldiers were lying around the tents, apparently unconcerned. It is needless to say that we lost no time in crossing the 200 yards of bare space that lay ahead of us.

On this side of the mountains there were many evidences of the devastation wrought by the Spaniards since the beginning of the insurrection. Coffee, cocoa, and sugar-cane were growing in abundance; but had been uncultivated for a year or more. Houses had been burned, and the small sugar-mills destroyed. Only old men, women, and children were seen. All the able-bodied men had gone to the woods and joined the insurgents.

Shortly before sundown we reached the headquarters of an insurgent battalion posted on the road that led from Santiago to Manzanilla, the same road over which Colonel Escario's column afterwards succeeded in reaching Santiago. General Rabi had sent a letter by Masaba to the colonel of this regiment directing him to give us all required assistance for passing through the enemy's lines. The colonel called a number of his scouts to conference, and the situation was talked over. The insurgents estimated that there were about 700 Spanish troops posted in various places guarding the roads that passed through that locality. Small detachments of the enemy were constantly moving back and forth through the 15 miles of country that separated the Cuban forces from Santiago Bay; and on account of the dense growth on the hills and in the valleys, the problem was to find a trail over which we could reach the bay without falling in with Spanish soldiers. After considerable discussion among the scouts a route was decided upon, and our party, which had been increased by three soldiers on foot, left the Cuban camp, and much to my surprise took the main road towards Santiago. How they expected to go through the lines unseen on that road was more than I could understand, but as I knew nothing of the country it only remained for me to follow blindly and say nothing. We followed this road for about one and a half miles, and after descending a hill left the road and plunged into a dense forest, which seemed almost impenetrable from the outside. Just as we were leaving the road about 20 Spanish soldiers emerged from the woods on the hilltop 200 yards behind us. We were informed of this the next day by a "pacifico" who happened to be on the hill at the time. As we did not see the Spaniards, it is safe to assume that they did not see us.

Soon after leaving the forest night came on, and it was necessary to dismount and lead the mules as we felt our way through the darkness, stumbling over logs and sinking knee-deep in mud. After crossing a small stream, Masaba, who had been more quiet than usual, turned to me and said, "we are now in the enemy's country." Two hours' time was consumed in passing through the swampy jungle when more open country was reached. The guides found a trail, which we followed for about half a mile, when they concluded that it was unsafe to go farther that night. As we had twelve miles to travel before reaching the bay, my desire was to get there before daylight. The Cubans, however, replied that, on account of the Spaniards constantly changing their positions from day to day, it was absolutely necessary to proceed in the daytime, when we could see our way ahead and also obtain information of the enemy's whereabouts from the "pacificos" who lived in that district. After deciding to wait until morning before proceeding farther, we left the trail and began to look for a suitable place in the woods in which to sleep. A light was seen several hundred yards away, and one of the soldiers was sent ahead to reconnoiter. He returned after a while and reported that the light came from a house in which a half-breed Frenchman, who was a Cuban sympathizer, lived. This man and his wife proved to be very hospitable as far as their scanty means would allow.

They told us that had we followed the trail a half-mile farther we would have fallen in with a detachment of Spanish soldiers that had taken position there that afternoon. From that time on my faith in the wisdom of the guides increased. After making a supper on some dried beef and coffee, furnished by the Frenchman, and hard tack and sardines from my haversack, the three soldiers were posted as sentries and Masaba and I retired for the night. It made no difference that my bed was a brick floor and that the air was thick with mosquitoes, the fatigue of the day's journey made me oblivious to things so trivial. I was waked in the morning before daylight by inhaling the smoke from a wood fire in the middle of the room, where the Frenchman's wife was making coffee.

We started soon after daylight on a road recommended by the Frenchman, who said it had been occupied by troops until the previous day, when the detachment moved elsewhere, and that if we got an early start we could pass over a certain distance before the arrival of another detachment expected from Santiago. We had not gone far before we heard the sound of musket firing in the woods on our right and rear, the result of a skirmish between the Spaniards and the insurgents we had left the evening before.

On the road we met from time to time quite a number of "pacificos," all of whom seemed to be loyal Cubans who were anxious to give us information as to how we should proceed in order to avoid the Spanish soldiers. In fact the advice given by these people prevented our falling in with troops on several occasions.

In order to explain our mission and perhaps to magnify the importance of it in the eyes of these ignorant people, Masaba told them that I was going in to destroy the Spanish fleet with dynamite. I think he even went so far as to tell some of them that I was Admiral Sampson, as on our return trip several of them asked me if I was the Admiral.

As we advanced towards the bay, changing our route from time to time as advised by "pacificos," we occasionally saw camps of Spanish troops on our right and front. Finally, ascending a hill, Masaba dismounted and told me to do the same. As we led our mules up to the crest and peered over we saw before us a hundred or more of the enemy's troops lounging about their camp at the foot of the hill. But what was a more inspiring sight was the city of Santiago and the bay. We were looking down on the deck of one of Cervera's cruisers of the Viscaya class. Some distance down the bay was another of the same class. We reached the crest of the hill just in time to see one of the destroyers disappear behind Smith Cay; the other was steaming down the bay.

It was a beautiful Sunday morning, clear and warm. A gentle breeze blowing from the eastward somewhat counteracted the rays of the tropical sun. The two armored cruisers were lying peacefully at anchor with awnings spread; their boats quietly swinging at the booms, and their colors waving in the breeze. Near the city were a number of steamers, among which was the trim little gunboat Alvarado. I was deceived in thinking two of these steamers were small cruisers on account of their neat appearance; one, in particular, the Mexico, with her elliptical stern and quarter-boats might have deceived the most practiced eye.

From our position on the hilltop the two destroyers and two armored cruisers of Cervera's squadron had been seen; but where were the other two? Could it be possible that the rumor was true that they had not gone into Santiago? There yet remained to be examined certain parts of the bay that were shut from our view by trees on the intervening hills.

Proceeding in the direction of the city for about half a mile we climbed another hill several hundred feet higher than the first, and from there viewed the third armored cruiser. This disposed of the Maria Teresa, the Viscaya and the Oquendo. From this place of observation nearly the entire bay was in plain view, but the Cristobal Colon was yet to be found.

The western part of the bay south of Cay Ratones was still closed, and in order to open it out, it was necessary to retrace our steps and go several hundred yards beyond the first place of observation towards the sea. While going in this direction, and stooping in high grass in order to conceal ourselves from the Spaniards, whom we were gradually approaching, suddenly a military mast loomed up among the treetops, then a smoke-pipe, and finally the hull of the Colon came into view. Our work was finished; the desired information had been obtained, and it now remained for us to return to where the mules had been tied, and then to get across the twelve miles that lay between us and the Cuban battalion as soon as possible. While returning we found that news of us had gone abroad among the "pacificos." But loyal as they were, they kept their knowledge from the Spaniards until we were well out of harm's way. After the war a Spanish officer told me in Santiago that the Spaniards heard of this reconnaissance the day after it was made.

On returning, our intention was to pursue the same route over which we had come, and this we accomplished for a distance of seven or eight miles, when we were stopped by an old man who gave the startling information that Spanish soldiers were on the road ahead. As this was the only road known to be clear of troops early in the morning, we decided to disperse. Masaba and I struck out through the woods in a southwesterly direction, leaving the three soldiers to look out for themselves.

For four or five miles we traveled through a rough and broken country, sometimes in thick underbrush and sometimes in the open, occasionally taking a road, only to leave it again when advised to do so by the "pacificos." All along this route desultory firing was heard on our right and left, but no Spaniards were seen.

About nine o'clock that night we arrived at General Rabi's headquarters at Aceraderos, and the next morning at daylight the Suwanee's whaleboat met me at the landing according to the pre-arranged plan.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE TAKING OF ILO ILO.

By LIEUTENANT A. P. NIBLACK.

With all the hundreds of islands and the numerous mixed and indigenous people in the Philippine and Sulu archipelagoes, the whole question, political, commercial, geographical, and strategical, may be simplified by regarding the Philippines as divided into three groups or districts, and the Sulu archipelago as constituting a fourth. These four groups are, roughly:—

1, Luzon and Mindoro Islands, in the North, with an area equal to Ohio, and a population of 3,500,000.

2, The Bisayan district, between Luzon and Mindanao, a belt of islands from Palauan on the West to Samar on the East, inclusive, and also Calamian, Panay, Negros, Cebu, Bohol, Masbate, and Leyte with an area equal to Kentucky and a population of 2,500,000.

3, The Island of Mindanao with an area equal to Indiana and a population of 500,000.

4, The Sulu archipelago with an area less than Rhode Island and a population of 100,000.

The primitive people of the islands are generally supposed to have been the Negritos and numbering about 10,000. They are found now only in the islands of Luzon, Panay, Negros, and Mindanao, and resemble the Papuans of New Guinea. They are known also as the "hill-tribes," having been driven into the interior by the Malayan invaders. Their principal weapon is the bow and arrow, and, as they are rapidly disappearing, they are not a political factor.

Fully eleven-twelfths of the native population of the archipelago is of Malayan blood and the number of dialects or separate Malayan languages spoken is about fifty.

The Tagalas of central and southern Luzon are comparatively a pure Malayan type and have been the real instigators of the insurrection; the Bisayas are more industrious, more gentle, and more adaptable. The sentiment between them and the Tagalas is not friendly.

The principal tribes of Mindanao and the Sulus are of the Mohammedan faith, and are known as Moros. They are of mixed Semitic and Malayan stock and evidently invaded the islands from Borneo. Between them and all other tribes there has been continued warfare, as they are a treacherous, indolent, fanatical race, given to robbery and violence.

The island of Mindoro, which should not be confounded with Mindanao, is really a part of Luzon in the sense that its population is of the same stock and all its trade is with Manila and ports on Luzon adjacent to its own shores.

The northern part of the island of Luzon, cut off as it is from the central by high ranges of mountains, is peopled by numerous tribes of mixed races varying in different proportions of Malay, Chinese, Japanese, and Negrito. They are not all friendly, by any means, either with one another or with the Tagalas. The point which it is endeavored here to bring out is that the insurrection was initiated by the Tagalas. Hostility to us in other parts has been largely due to their emissaries and their intrigues. The talk of a "Filipino Republic" is a Tagala dream. How they are to dominate the hundreds of islands without a large navy, and how representation could be effected and harmony brought in a legislative assembly where from twenty to thirty languages must be spoken, has not as yet been made clear.

Spain has held the islands for three hundred years, and why the Tagalas should dominate since they too are invaders of an earlier period has also not been made clear as an ethical proposition. Sentimental sympathy for the struggling but designing Tagalas should be largely confined to their own ranks.

Ilo Ilo is the capital of Panay, possesses a fine harbor, and is the principal port in the Bisayan group, being commercially next in importance to Manila, and also the headquarters of the sugar trade.

Cebu, the capital of the island of the same name, was the first town occupied by Magellan, in the name of Spain, in 1521, and is now third in importance commercially, being the center of the hemp trade.

Not much is known of the island of Mindanao except by hearsay, as Spain pursued the singular policy of prohibiting exploration and forbidding publication of accounts of the island. Enough is known to stimulate enterprise and attract adventure. Unfortunately, the Moros are a fanatical, fierce, lazy, uncertain, unsociable, and unscrupulous race, and they must first be dealt with. There are two large placer gold-mining districts in the north; the island is remarkable for its timber; it is said that it has everything which grows or is found on the other islands, and, besides, nutmegs, cinnamon, pepper, and other spices which thrive as nowhere else. If this is true, then Mindanao must be rich indeed, since the Philippines in general can boast of sugar, hemp, cotton, rice, tobacco, coffee, wax, timber, sapan wood, indigo, copra, spices, pigs, chickens, cattle, hides, sulphur, iron, coal, marble, kaolin, lead, mercury, copper, silver, gold, platinum, pearls, mats, textiles, hats, cordage, etc., etc., as natural and industrial products.

As for the Sulu group, the Spanish have never been able to collect any revenues and their occupation has only been effective in the last few years. They had military garrisons in three principal islands, Tawai-Tawai, Sulu, and Basilan, the last-named being a naval station. From this naval station across Basilan Straits to the Spanish garrison town of Zamboanga on the island of Mindanao is only fourteen miles. Spain has now withdrawn all her garrisons in Mindanao to Zamboanga, and we shall have to make a fresh conquest of the whole island. As to the Sulu archipelago in particular we shall be obliged to police the islands by means of gunboats. The Dutch have a talent for handling these East Indian people and besides have native troops and native police. We shall never be able to make anything out of the Sulus and they will prove a veritable white elephant. If we could exchange them with Holland for the island of Curaçoa in the Caribbean Sea, for a consideration, we should be fortunate and it would also secure us a good neighbor in the Philippines.

Practically the five centers of interest in these islands are Manila, Ilo Ilo, Cebu, Zamboanga, and Sulu, the latter being the garrison town on the island of the same name, and former residence of the Sultan of Sulu who was practically deposed by the Spaniards.

The First Expedition to Ilo Ilo.

The first expedition to Ilo Ilo from Manila sailed from the latter port on Tuesday, December 27th, 1898. With the fall of Manila and the signing of the Peace Protocol in the previous August, the United States was under the moral obligation to make no further change in the *status quo* in the Philippines. It appears, however, that the continued activity of the insurgent troops against the Spanish garrison of Ilo Ilo, now cut off from direct reenforcement and succor, had led the Spanish Commander, General Rios, about the middle of December, to declare his intention of evacuating the city and withdrawing his troops to Zamboanga in Mindanao. The merchants of that city, none of whom were Americans, petitioned General Otis to send an expedition to relieve the Spanish garrison. At the same time the insurgents made a similar request. Had a prompt answer been given General Otis from Washington, Ilo Ilo might have been occupied with the consent of the people. It was eight days before instructions were received and it is said that the orders were "*to take Ilo Ilo, but do nothing which would bring on a conflict with the natives.*"

The expedition which started, as stated, on December 27th, consisted of the transports Newport, Arizona, and Pennsylvania, on which were embarked respectively a battalion of the Sixth U. S. Artillery, the Eighteenth U. S. Infantry, and a regiment of Iowa Volunteers, which latter had left San Francisco some months previously and had never been disembarked. The expedition was commanded by Brigadier General Marcus P. Miller, U. S. Volunteers, but holding a commission as Colonel in the regular army, a popular officer of ripe age and experience. The expedition was in every sense an *Army* affair, although the U. S. S. Baltimore acted as convoy. The Admiral opposed the proposition to send the expedition when it was originally contemplated; and after orders came to send it, he predicted its failure for the very reason that it did afterwards fail. To take a place without hurting anybody's feelings, particularly in the Capitol at Washington, is not an easy matter, and General Miller's position was not an enviable one.

On December 21st General Rios had called a meeting of the foreign consuls at Ilo Ilo and told them that he had a telegram from Spain saying the islands had been acquired by the United States and that he did not feel justified in sacrificing Spanish soldiers in nightly encounters with the insurgents. He therefore announced his intention of withdrawing his forces and turning the town over to the Spanish *alcalde*, requesting the foreign consuls to protect foreign property. He entered into negotiations with the insurgents to capitulate, with the understanding that he should be allowed to carry away all the government property he could.

On Saturday, December 24th, the Spanish troops left Ilo Ilo for Mindanao. The German cruiser Irene took over the protection of foreign interests, but the universal testimony is that the insurgents in entering the town behaved in the most exemplary manner. The Spanish *alcalde* turned over the city to them and is credited with the remark that he hoped they would "be able to defend it against all invaders."

Many people are inclined to think the Spaniards acted in bad faith in the matter, but the position they were in was really thankless. Had we sent an adequate force at once when requested we could have assumed peaceful possession. The delay was responsible. However, the action of the Spanish General raises a nice point in international law as will be seen later.

The expedition sailing from Manila met at sea the regular mail-steamer from Ilo Ilo, and, on communicating, learned of the situation there. On the arrival of the Newport and Baltimore, the other two ships remaining outside, a delegation of insurgents came on board to ascertain the intentions of General Miller and the purposes of the expedition; also what recognition was going to be given them. General Miller promised to write them a letter next day explaining his position.

Mr. F. J. Bass, who was special correspondent of "Harper's Weekly," and who was, with permission, on board the headquarter's transport, the Newport, says in his account of the expedition printed in the issue of March 18th, 1899, page 268, speaking of the day of arrival:—

"I went on shore and found only a few soldiers in the town. The old fort was unoccupied. Certainly, had we landed then and asked permission afterwards, our explanations would have received more serious consideration than they did. Nearly all of the insurgent troops were two miles distant, across the river, at

Jaro. The insurgent flag was down, and the insurgents evidently expected us to land. I am persuaded that we made a mistake in not landing then and there. . . . When I landed at Ilo Ilo, I think a dozen men might have raised the United States flag without much difficulty. I staid in the city five days. At first I was treated with respect and allowed to go wherever I pleased. Little by little a change came about. With every communication we sent, with every evidence of hesitation we showed, the insurgents gained confidence, until, at last, I was obliged to leave the town on account of their hostile attitude; . . . gradually they took heart and began to fortify the town. They took possession of the old fort, and threw up earthworks along the strip of beach. . . . When I left Ilo Ilo for the Newport there were two thousand armed men in town, who patrolled the place constantly. The streets were being barricaded."

The letter which General Miller had sent on shore was in conformity with his instructions. He stated that his expedition had come expecting to take the town from the Spanish, and he did not wish to have any trouble with the insurgents. It ended by stating that he had come on an errand of peace, and wanted to know what the insurgents would do if he landed. Messages and visits were exchanged, the insurgents first requesting and then demanding time to send to Manila to consult Aguinaldo. The fact is the emissaries of Aguinaldo were then at Ilo Ilo stirring up all the trouble.

Mr. Bass says:—

"General Miller, an old Indian-fighter, who had chafed under his restricting orders, now openly declared that he had come to take Ilo Ilo, and was bound to do it; that he wished to avoid bloodshed, but as the insurgents were not open to advances, they must take the consequences." . . . "The guns of the Sixth Artillery were lowered into boats, the Eighteenth United States Infantry was in marching order ready to land; the Iowa Volunteers prepared to follow."

The landing did not take place, for the merchants of Ilo Ilo, learning that the insurgents intended to burn the town, petitioned the General not to land. The proclamation of the President and the special version given by General Otis were brought down by a foreign man-of-war. Then the insurgents determined to fight. All this happened in the three days following the arrival of the expedition.

General Miller then sent Col. Potter to Manila for orders. Admiral Dewey at once sent the gunboat Petrel to Ilo Ilo with instructions for the Baltimore. Her arrival was signalized by the insurgents sinking four large iron dredging scows, loaded with stone, in the mouth of the river, to block any attempt she might make to enter. Meanwhile all non-combatants had left the town, taking with them all their household goods. The merchants had loaded as much of their property as they could on lighters, and towed them out of danger across the bay. They themselves took up quarters on the various steamers in the bay, and it looked like war.

Meanwhile a regiment of California Volunteers was embarked on five chartered steamers at Manila as a reenforcement for Ilo Ilo and the Concord detailed as convoy. After some twelve days' delay they were disembarked and a few days later their baggage and stores were sent on shore. The expedition was then definitely abandoned.

On January 31st the transport Pennsylvania returned to Manila and landed the Iowa regiment which had been on board nearly four months. The *status quo* as to ships and transports remained the same at Ilo Ilo for six weeks, while the ratification of the Treaty of Peace was pending in the Senate.

THE SECOND EXPEDITION TO ILO ILO.

There was in a certain sense no "second expedition" to Ilo Ilo. The Boston replaced the Baltimore and the St. Paul brought down the Tennessee Volunteers. This happened as follows:—

The sending of the Commissioners to the Philippines and the necessity for sending a suitable man-of-war to Hong Kong to meet them led to the relieving of the Baltimore at Ilo Ilo by the Boston in order that the former might perform this duty. It was my good fortune to be transferred at this juncture to the Boston as Acting Navigator during the illness of another officer. She sailed from Manila the day after the breaking out of the insurrection at Manila early in February with a full knowledge that orders would follow later to take Ilo Ilo. Arriving on February 8th she relieved the Baltimore which sailed immediately. On February 10th the Army dispatch-boat Butuan arrived at Ilo Ilo bringing Col. Potter with news of the ratification of the treaty and orders to take the place. By direction of General Miller a conference was held on the Newport at 1.00 P. M. of that day. It was announced that the transport St. Paul would arrive in the evening with the Tennessee Volunteers. It was decided that the insurgents should be given till sunset of the 11th to evacuate and to be notified also that if in the meantime they threw up intrenchments, reenforced their defenses, or put further obstructions in the river, the men-of-war and transports would open fire at once. It was also agreed that the Army should use two of their own steam-launches and a third small steamer, expected that night, to tow their boats for landing. Captain G. F. F. Wilde, U. S. Navy, commanding the Boston, and Commander C. C. Cornwell, U. S. Navy, commanding the Petrel, stood out for only twelve hours' notice or till daylight, but General Miller overruled and decided for sunset next day as the hour to be named. Notification was accordingly sent ashore to the insurgent forces at 4.00 P. M. of the 10th and the Boston and Petrel cleared ship for action and moved over near the fort in such position that each could drop shells into the flank of the trenches facing the other ship (see diagram) without firing in the direction of the town. The Petrel was 500 yards and the Boston 900 yards from the center of the fort.

At daylight next morning a reconnaissance by the Boston's steam-launch close in shore showed everything quiet, but the Petrel reported a movement of troops in the fort, apparently an attempt to relieve the garrison. At 8.20 A. M. she signaled "Troops are throwing up intrenchments on the beach." At 9.00 o'clock she fired two warning 3-pounder shell at the new trenches killing several people. This of course precipitated matters. Troops poured into all the trenches as reenforcements and a field piece came into line while several generals rode back and forth on ponies busily giving orders. It will be noted that the insurgents violated the order in intrenching themselves and reenforcing their trenches. Captain Wilde took full responsibility for the Petrel's action by signals which were almost continuously exchanged.

At 9.35 A. M. the insurgents began firing on the Petrel at close range, and she opened fire followed by the Boston. It was not long before the fort and trenches were untenable and by two's and three's they slipped away, setting fire to the town and looting as they went. Then two riderless ponies appeared coming out of the fort and several generals crawled behind sand-bags and crossed the zone of fire to join their fugitive troops. A masked battery on the other side of the river, consisting of a few antiquated cannon, opened fire on the Newport early in the action and in replying some of her shell evidently fell into the business part of the city. This is mentioned, because, in retaliation for setting fire to the town, the Boston commenced from the first to drop an occasional eight-inch shell over the city into Jaro and Molo, two native towns near Ilo Ilo, and kept this up till after two in the afternoon. It was said that some of her 8-inch shells must have exploded in the air. As the shells complained of were afterwards found to be a caliber of about three inches, they came from neither the Boston nor Petrel, and did correspond with the Newport's battery. Soon after the original firing began, Captain Wilde had signaled General Miller that the insurgents were throwing up intrenchments and firing on the Petrel. At 10.20 General Miller signaled "Do you desire landing party now?" and when replied to in the affirmative signaled "If you desire landing party send steam-launch and three boats to Arizona for towing and landing." As the Arizona and Newport were anchored fully a mile and a quarter from the fort with a strong flood-tide against them, as Captain Wilde had strongly advised moving closer, and as it was distinctly agreed that the Army should tow its own boats, Captain Wilde saw that the city was in danger and acted promptly. A section of infantry under Ensign Everhart and a gatling section under Ensign Hough, with Asst. Surgeon Blakeman and a couple of signalmen, were prepared for landing. Just then the Army launch Samar came alongside with General Miller and all his staff on board and General Miller asked Captain Wilde if he thought the troops should be landed. Captain Wilde's reply was not particularly soothing in its character but was strongly affirmative. He ordered the men from the Boston to be landed at once and signaled the Petrel to land a squad in support. Being permitted to command the Boston's landing party of some fifty all told, not counting two or three who sneaked in at the last moment, it is a great pleasure to state that we landed according to the drill-book, we deployed according to tactics, and we shinned up the wall of the fort with the best man first, and found the fort deserted, except by one of the ponies of the numerous generals. We hauled down the insurgent flag and hoisted the Stars and Stripes in the Bisayas, let us hope never to come down again. The Petrel's men had meanwhile occupied the trenches, where we then joined them. On comparing notes with Lieutenant Plunkett, who commanded the Petrel's section, I found he had orders to skirmish along the beach and stop sharpshooters who were annoying the Petrel, principally however, by nearly hitting two British gunboats which were lying near. We were cautioned by several foreigners whom we saw that the insurgents would fire at us from the houses if we went up town; but having received discretionary orders from Capt. Wilde, it seemed our duty to push on. The Boston's party was formed for street riot, and, following the usual custom in such cases, as senior officer present I confiscated the general's pony which one of my juniors was riding and rode at the head of the column. We conceived it to be our business to protect lives and property; to put out fires; to arrest looters; to chase out insurgents; and to cover the landing of the Army. This we did. The very first move was to detail a patrol for the warehouse district which had so far escaped the fire and to station a guard at the Hong Kong and Shanghai Bank against which three attempts had already been made We did what we could in saving property from burning houses, and we saved many cans of kerosene which had not yet become ignited as originally intended. By 12.30 we reached the custom-house and could get very little further as we were hemmed in either by fire or the river. We settled down to trying to save a large warehouse adjoining the custom-house, well knowing if it went up that the latter would be lost. It was filled with alcohol, wine and other inflammables, and while one section of our party was exchanging shots with some of the insurgents across the river, the rest of us were working in the warehouse, and also in trying to persuade a few fire-crazy ponies to leave their burning stalls. In the skirmish one of our men was shot in the foot but was further disabled by opening the surgeon's canteen while that officer was stooping over examining his injured member. He, however, added realism to the situation by being loaded on the gatling carriage in a limp condition. The Army began to appear on the scene a little before one P. M. and our career came to an end.

It appears that some time after our party had disappeared up the beach, Captain Wilde signaled General Miller "Why don't you bring your ships close up to the beach so you can land your troops?" The St. Paul with the Tennessee Volunteers on board had arrived the night before, and, when given permission to land, promptly put their ship close up to the beach and landed. The first troops ashore struck the beach at noon. They saw the Petrel's party returning to their ship and they supposed it was the entire naval force. It was not until three quarters of an hour later, when they arrived as far as they could go that they discovered that they had not taken the city.

General Miller and staff arrived a few moments later and, after some little delay in getting ponies to suit everybody, I was able to negotiate for the return of myself and party on board ship, having successfully covered the landing of the Army as is the part of the Navy in joint operations. I tried to emphasize the request that the guard at the bank should be regularly relieved, and that the work of saving the custom-house should go on; but a fire does not appeal to a soldier as it does to a bluejacket, and we returned on board taking the guard away from the bank. We reached the ship about 1.45 P. M., wishing we could have gone earlier and staid later.

A little afterwards, wishing to communicate with General Miller, Captain Wilde permitted me to take the steam-launch with a one-pounder and a gatling, and ten picked men, and with Paymaster Martin as a volunteer, we went up the Ilo Ilo river to the Jaro bridge, firing at various nests of insurgents on the left bank who were annoying the Army's sentries on the right. We hoisted the steam-launch's flag (having no other) on the governor's house, and placed a guard; saw General Miller; interviewed many business men in town; saw all of the foreign consuls; made a rough note of all the houses burned in the European quarter, and reached the ship about dark, passing at the entrance of the river the last of the total Army contingent of 2300 men being towed up to town to be landed, and noting that the fire near the custom-house had doomed that building.

I am convinced that it was most fortunate that the fight came off prematurely, and before they had time to arrange to burn the whole city. Had it commenced at sunset as planned there would doubtless have been much loss of life and a general conflagration. As it turned out, the entire native and Chinese quarters were destroyed, and the entire street of small shops was looted and burned. The British, German, and American consulates (our representative was British), a German apothecary shop, the large warehouse, the Club, the Custom-House, the Captain of the Port's office, and three or four private residences (all Swiss) were burned.

There is a nice point in international law involved in this destruction of foreign property in Ilo Ilo. General Rios knew the islands would be ceded to the United States by the Treaty of Peace and that an Army expedition was coming to Ilo Ilo. The transfer of sovereignty to us could only take place when we gained possession. Either the consuls should not have acquiesced in the evacuation and assumed any responsibility, or else Spain has not escaped the responsibility. The United States is certainly clear in the matter.

THE AFTERMATH.

Within forty-eight hours after landing, the Army had spread out over the arc of a circle, including Jaro and Molo, and then settled down to an occupation of these lines waiting for reenforcements.

The Petrel carried the news to Manila of the taking of Ilo Ilo, and on February 14th it was known in Washington. General Miller's nomination as a Brigadier General in the Regular Army was sent in, and was confirmed on the following day, in recognition of the success of the expedition. As he retired at the age of sixty-four some six weeks later, the taking of Ilo Ilo was most opportune.

Immediately after the fall of Ilo Ilo Captain Wilde nominated Ensign Lay H. Everhart, U. S. Navy, as Captain of the Port of Ilo Ilo. That officer entered upon the discharge of his duties with such zeal and judgment that in a short time the commerce of the place was restored and the office thoroughly reorganized. The position of Captain of the Port, following the Spanish custom, is most important. This officer is charged with all matters relating to shipping, pilotage, clearances, discharging and loading ballast and cargoes, harbor-regulations, water-police, docks, public works, harbor-improvements, buoys and lights, immigration, admiralty cases, etc., and is second in importance to the *alcalde* of the port, being answerable directly to the governor of the province. Owing to the pressure for officers, Everhart was relieved from the duties on April 1st, but his services there will not soon be forgotten.

In connection with the opening up of the commerce of Ilo Ilo the writer spent two weeks in charge of the wreck-raising operations in the mouth of the river, which were successful. These little services of the Navy are mentioned here, since news filters very uncertainly from these parts, and the Navy's work in the interest of commerce should not be overlooked.

On the return of the Petrel from Manila, Captain Wilde detailed her to go to Cebu to try diplomacy with the natives there. She arrived February 20th and Commander Cornwell by his cleverness and judgment succeeded in peacefully occupying the fort and defenses on February 22nd, the natives contenting themselves with a formal written protest. Lieut. J. P. Parker, U. S. Navy, was appointed Collector of Customs. Lieutenant Plunket became Captain of the Port, and Commander Cornwell took over the office of Governor of the island. On hearing the news, as brought to Ilo Ilo by steamer, Captain Wilde sent a detachment of fifty bluejackets under Ensign De Witt Blamer from the Boston to assist in garrisoning the town.

Later all were relieved of their duties on shore by details from the Army from Manila, but the Petrel remained as guard-ship, and their relations with the people of Cebu were at all times most cordial and satisfactory.

A few days later the people of the island of Negros sent a delegation to Ilo Ilo and thence to Manila to negotiate, and shortly afterwards the Army took over the management of affairs there.

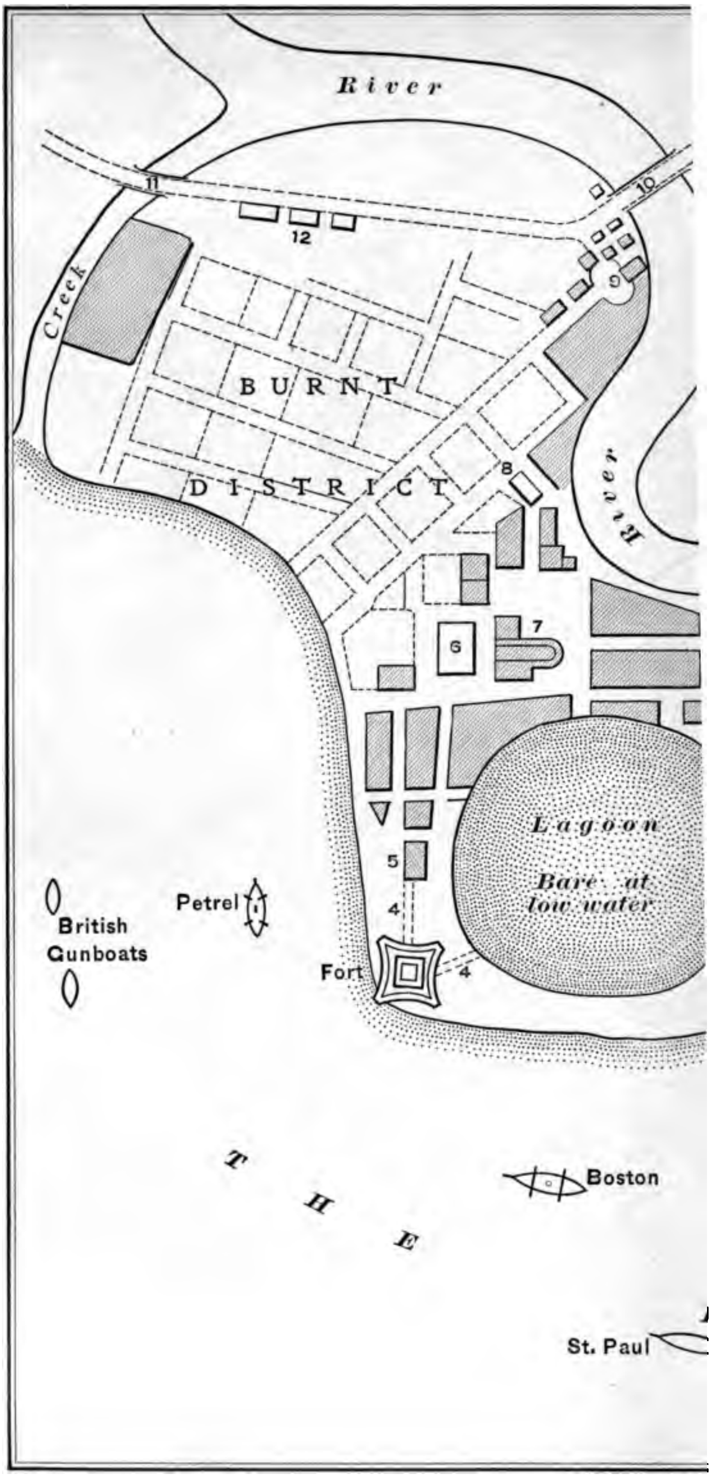
Personally it has been my good fortune since January 1st to cruise from the Sulus on the South to the North end of Luzon, and I have become impressed by the beauty of the islands and their undreamed-of possibilities. Manila is not the Philippines but every one seems to want the world to believe it. This is particularly true of a few Tagala sea-lawyers with a gift for writing clever proclamations and with diplomatic ability enough to throw dust in the eyes of the world. They are after the custom-house, and they want to run all the islands. They really represent themselves and a small following in the suburbs of Manila. Their troops are misguided and deceived by them. The Philippines are more than worth almost any sacrifice, although just now many look upon them as a white elephant. We have, however, fallen overboard and must learn to swim, and we don't need any one's help in the matter either. There is one thing, however, we must get rid of and that is our artificial, narrow, and senseless prejudice against the Chinese, who, of all the Asiatics, are individually the only trustworthy, commercially the only honest, and as employees the only faithful people who are at hand as the true instruments to use in making these islands a veritable treasure trove. To restrict them in any way will be a political blunder and commercial suicide.

A final word as to the taking of Ilo Ilo. In Army circles there is a feeling that the Navy took a rather unfair advantage of the Army in landing first. This cannot be easily dispelled.

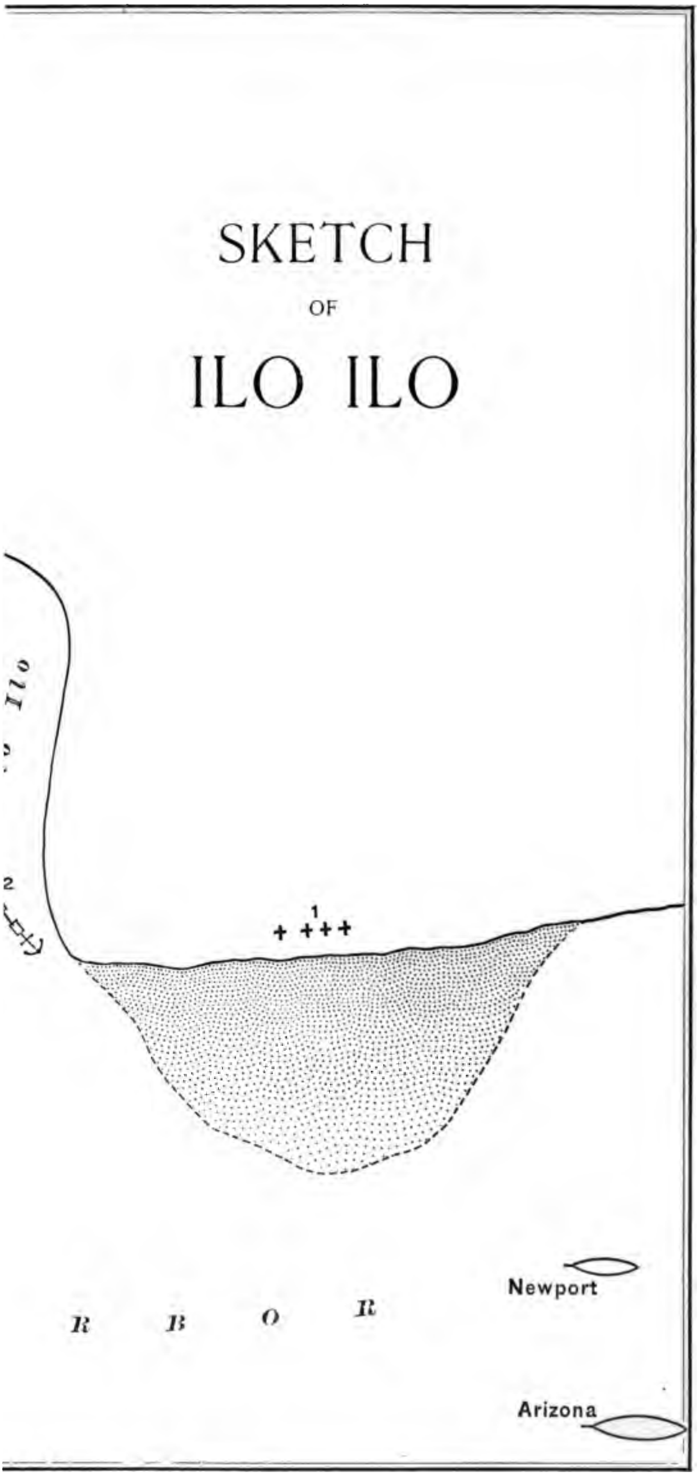
Any ship in the Navy can land its battalion on ten minutes notice. The knowledge that a landing party would be required at Ilo Ilo was not a secret. There was not a moment after 10.20 A. M. that should have been lost. Waiting half an hour as we did was sufficiently trying, and then to find that the Army was still doubtful as to the necessity and still hesitating, it was simply the plain duty of the Navy to land.

When the Army did land, the men were without the two days' cooked rations which are regarded as essential. It is difficult to feel sufficiently apologetic. The unfairness will always occur where one well organized body meets one not so well organized. It is all but impossible for the Army and Navy of the United States to cooperate; but the importance of their cooperation has never been brought home to the country by the national disaster thereby invited, and neither branch has ever had the licking each needs to make it try harder. Still it is less the Navy's fault than appears on the surface. The Army has charge of the seacoast fortifications, harbor defenses, and transport service, which are really naval duties. Congress gives us Army pay less 15 per cent. No wonder that in joint operations we are regarded simply as a convenient accessory. It only remains now for the Army to get a Navy of its own to dispense with us entirely. Judging by present Army ideas no previous training would be a necessary requisite to be an officer in their Navy, and this is not a mere pleasantry either.

The country has in the Navy and Marine Corps a harmonious, homogeneous, well organized, economically administered military service perfectly adapted to colonial purposes. In a lucid interval the country may see the economy and efficiency of such an arrangement and use it for what it is worth.



1. Masked Battery.
2. Wrecks in Mouth of River.
3. Light-House.
4. Trenches.
5. Stone Warehouse used as
6. The Plaza.



7. The Cathedral.
8. The Custom House.
9. The Governor's House.
10. The Bridge to Jaro.
11. The Bridge to Molo.
12. Barracks.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE HYGIENE OF THE NAVY RATION.

BY HENRY G. BEYER.

In recording some observations on the navy ration which the writer had an opportunity of making during last winter, he desires it to be understood at the outset that this paper is not intended to criticise adversely the present navy ration nor those who may be responsible for the same. Neither is it, on the other hand, the intention to look at things through the spectacles of that very engaging list of eatables which is passed around immediately, the moment the word "ration" is pronounced in certain quarters. We propose to look at the navy ration and its administration with unprejudiced eyes, armed only by a few simple but telling experiments. It does not require a great deal of experience to know that there is as yet a long way from a market or even a bill of fare to the inside of a man's stomach. If, therefore, it should suggest itself to the reader of this paper that certain steps on this way might put up with some very desirable improvements, let it be remembered that all such improvements have originated in criticisms prompted by the proper motives and rendered in the right spirit.

A ship's company is generally divided into a number of messes, each consisting of about twenty or more men, with their own cook and mess attendants. The quantity of stores served out to each mess by the paymaster of the ship varies, of course, with the exact number of men in a particular mess. There is on every ship a chief cook and several assistant cooks (?), attending, as well as they know how, to the preparation of the food; the mess attendants, or berth-deck cooks, having charge of the serving out of the food and, also, of the mess gear, its cleanliness, etc.

Long experience and observation having demonstrated the necessity for reorganization of this antiquated system of messing, a most laudable attempt was made quite recently to put into practical operation a "consolidated mess," one which is to include all the enlisted force on board ship with the exception of the chief petty officers.

Thus, the consolidated mess of the U. S. S. Indiana, as described by Lieut. B. C. Decker, U. S. Navy (Proceedings U. S. Naval Institute, No. 83, 1897), consisted of about three hundred and eighty men, a ship's cook of the first class, two cooks of the second class and four of the third class, a commissary yeoman, and a storeroom keeper. Without going into the details of its organization at the present moment, it will suggest itself to everyone having even but little experience with messing large bodies of men, that the proposition, made in this system of messing, to engage a higher quality of cooks and a better class of mess attendants than heretofore, is not the least important of its many good and admirable points. According to all accounts which we were able to gather, under the conditions of this consolidated system of messing the men live not only better, but also cheaper. We shall find later on in this paper that this very general and very favorable conclusion finds some very interesting and firm support in the results of our investigations into the comparative food-values as existing in our unmodified navy ration furnished by the paymaster of the ship as compared to those of a mixed or combined ration, that is, one made up of a part of ship's ration and a part of food bought in the market out of the money obtained from commuted rations. In short, we are in a position to prove that the food-value of our ration increases in direct proportions to the number of ship's rations that are commuted; and this fact we are inclined to consider one of the strongest and most direct arguments in favor of the consolidated system of messing.

In view of our figures as regards the food-values of the ration alone, the most impartial judge would declare in favor of the commutation of all ship's rations; he would have the regular ship's ration, in its pure and unmodified form, relegated to the function of an emergency or iron ration, to be used only whenever ships are kept at sea and have, from necessity, no communication with any of the markets on shore. The physical condition of the men under such a system could not do otherwise but greatly improve.

Upon one point, however, the greatest possible stress should be laid in any and every attempt at mess reorganization, namely, the quality of the cooks and mess attendants. The waste, owing to bad management from that source, is very large and most deplorable. The most hungry stomach will refuse to eat things, not so much because they are not eatable, but because they are neither cooked nor served in a manner sufficiently inviting. If one of the objects of cooking is to render the food more pleasing to the eye, more agreeable to the palate, improve its flavor as well as its digestibility, we see, in the first place, that three of the keenest of our special senses demand to be favorably influenced before this one of the special objects of cooking can be said to have been attained. Man may, from a chemico-physiological point of view, be compared to a machine, needing only certain quantities of fuel in order to do a certain amount of work; but he is, to say the least, a machine endowed with special senses and a will of its own. The social position of man in this respect makes, if at all, merely a difference in degree, not in kind. Cooking, furthermore, is to alter the texture of our food-stuffs so as to render them more easy of mastication and subsequent reduction to a fluid state in the stomach; that is, to render them more easy of a perfect digestion and assimilation. The average cook, therefore, besides having to be thoroughly drilled in the special methods of boiling, stewing, roasting, broiling, baking and frying the food, must be taught to pay some attention to the appearances of his products.

Fortunately, any man gifted with the average amount of sense can become a good cook or mess attendant and can easily satisfy all the above requirements, providing he is properly taught, trained, and intelligently and systematically supervised in his work.

The two following tables represent, in food-values, the rations served out to, and of the additional articles of food obtained by purchase and consumed by, a mess of twenty men during a period of fourteen days.

In order to obtain a greater variety of articles of food for their table than that which they receive in the form of rations, and in order to, furthermore, take advantage of the fresh fruits and vege-

TABLE I.

RATIONS SERVED OUT FOR FIFTEEN MEN IN FOURTEEN DAYS.

	Weight, kilos.	Proteids.	Fats.	Carbo-hydrates.
Fresh Beef............	33.0	7.227	.297	.....
Canned Ham	11.5	2.760	4.197	.....
" Corned Beef...	11.5	2.545	1.610	.....
Pork, fat	6.5	.942	2.424	.....
Salt Beef	33.0	7.227	.297	.....
Butter...............	1.3	.11	1.196	.....
Bread	57.0	7.752	.427	33.630
Flour	9.0	.990	.180	6.408
Sugar	25.0	.35	.....	24.965
Beans	6.7	2.237	1.186	1.949
Potatoes	19.0	.380	.....	15.865
Canned Corn	2.0	.198	.92	1.368
" Peas	3.0	.660	.60	1.590
Turnips	7.7	.77	.15	.523
Cabbages	3.8	.190	.19	.296
Dried Fruit	1.3	.13	.....	.260
		33.244	11.990	86.834
Per man and per day ..	....	.158	.57	.442

Besides, the men received hardtack which was not eaten; they also received and consumed: 2.9 k. onions, 1 k. pickles, 3 k. coffee and 1.5 k. of tea.

Allow 15 per cent. for bones.

TABLE II.

ARTICLES OF FOOD, OBTAINED BY PURCHASE, IN FOURTEEN DAYS.

	Weight, kilos.	Proteids.	Fats.	Carbo-hydrates.
Beef..................	10.2	2.040	.357	.....
Ham	10.2	2.448	3.723	.....
Pork, fresh	6.0	.870	2.238	.....
Corned Beef...........	3.5	.815	.490	.....
Bacon	14.4	1.247	10.555	.....
Milk, condensed.......	6.7	.824	.737	3.272
Eggs, Nos. 288	14.4	1.944	1.670	.....
Liver	3.5	.700	.140	.....
Lard	5.7	.154	4.674	.....
Sugar	6.2	.35	.....	6.165
Bread	49.0	3.920	.735	24.098
Oatmeal	4.8	.604	.268	3.024
Rice..................	1.3	.91	.11	1.006
Beans	16.3	4.238	.326	8.802
Potatoes..............	86.4	1.728	.172	18.144
Tapioca	1.3	.10	.....	1.084
Macaroni.	1.3	.117	.4	1.001
Hominy	1.0	.120	.20	.710
Codfish	1.3	.351	.5	.....
Peas, canned..........	7.2	1.584	.154	3.816
Tomatoes, canned	7.2	.....	.....	.....
Summary	....	22.244	23.179	67.312

tables which the market offers at different seasons of the year, the men on board ship prefer to have one-fourth of their regular ration commuted; that is, converted into money. With this amount of money thus obtained, and as much more as each man is willing and able to pay into the general mess-fund, the men, simply buy those articles in the open market whichever they prefer. The twenty men under consideration then draw fifteen (¾) rations; their food-value is represented in Table I. Table II shows the food-values of the articles obtained by purchase in the open market.

These twenty men obtain in ration-money for a period of fourteen days 14 × $1.50 = $19, and pay out of their own pocket an additional sum of $23.75, making in all $42.75. The cook, also a member of the mess, pays nothing into the fund, and, besides, draws the value of two rations for his services out of it, which amount equals for the fourteen days $8.40, and which sum must, consequently, be deducted from the money spent for food, leaving a mess-fund of $34.35. This brings the money value of the mess shares per man and per day down to 13 cents.

The following Table, III, is intended to show in a condensed form the relations which the different values bear to each other.

TABLE III.

	Proteids.	Fats.	Carbo-hydrates.
1. Food-values of articles obtained by purchase,	22.244	23.179	67.312
2. Minus 10% of intestinal waste, leaves	20.020	20.062	60.581
3. Food-yalues of articles received in ship's rations	33.244	11.990	86.834
4. Minus 10% of intestinal waste, which leaves	29.920	10.791	78.151
5. Combined values calculated per man and per day	.181	.110	.495
6. After subtracting ¾ value of *full* and *corrected* ration	.107	.38	.300
7. Leaves individual values obtained by purchase, at $0.13	.74	.72	.195
8. As compared with food-value of full and corrected ration at $0.30	.142	.51	.398

The first four items on Table III, being perfectly plain and simple, need no further explanation, but the other four, perhaps, need a word or two more. Item 5 represents the value in food-material received daily by each man under the combined system; that is, that quantity which he receives when he draws ¾ of his regular ration and buys the rest of what he eats. Item 6 represents the ration and share in the combined value of food-material consumed by him. Item 7 represents the share obtained by purchase. Item 8 gives the corrected sum in food-material which a man would receive daily at a cost of 30 cents, if he would live on his ship's ration alone. A man's daily expense for food, under the combined system, is 35½ cents, or 5½ cents more than the value of a ship's ration. If we now compare the food-value contained in the full ration at 30 cents per day, with the food-value of that part of the combined ration which the men obtain by purchase at 13 cents per day, we will find that the latter is quite a little less expensive than an equal share of the ship's ration would be.

If the men, namely, commuted all their ship's rations and bought food at the same ratio as above, they would obtain an amount of food the value of which would be equal to, proteids, 171; fats, 167, and carbohydrates, 450; or about one-fourth better than is the value of the ration for the same amount of money which the ration costs them, or 30 cents a day.

It is but fair to mention that, in this estimate, we have not included the hardtack which, though not eaten by the men, is furnished them in the regular ship's ration. Inasmuch as we wanted to get at the food-value of those substances which were actually consumed by our men, these, however, refusing to take the same, we were naturally obliged to leave it out of our calculation. But even if this was considered a part of what the men had received, it would scarcely invalidate the conclusions reached, since the proteid value and the fat value of the ration, which are the most expensive part of it, would thereby practically remain uninfluenced. When our ration is examined more closely it can easily be seen that it is rich enough in carbohydrates without the hardtack, and the instinct of the men simply made them refuse it, because there was no need of it.

So far, however, we must admit that our estimates are only approximately true, and a closer investigation becomes extremely desirable. Fortunately, the Germans have furnished us with a method of doing this.

For the purpose of having a more uniform standard for comparison as regards the difference in money-values existing between different diets or rations, and because of the fact that one part of proteid is not exactly equivalent to either one part of fat or carbohydrate, the Germans have created a "nutrient unit" for food-stuffs, based upon the market value of the different articles of food. In accordance with this standard of the price of food-stuffs:

1 part of carbohydrates has the value of 1 nutrient unit;
1 part of fat has the value of 3 nutrient units;
1 part of proteid has the value of 5 nutrient units.

From this it is easily seen that proteids are the most expensive, while carbohydrate are the least expensive of food-stuffs, and this is true the world over.

Let us now calculate the nutrient units of the several rations which we wish to compare according to this standard, and contrast the results with the money-values for which each may be obtained:

The number of nutrient units contained in the corrected ration to be obtained from the ships' stores per man and per day for 30 cents is 1261. The number of units which the men obtained for themselves at the rate of 13 cents per man and per day amounts to 781. For 30 cents, or the value in money of the regular ration, the men could have obtained an amount of food containing 1802 nutrient units, or about one-third more than they received for the same amount of money in the form of rations from the ship's stores. Expressed in a still more simple manner, one cent will only buy 42 nutrient units in the form of ship's rations, while the same cent would buy 61 nutrient units in the open market.

The question might be asked: Is our ship's ration, in the quantities that are furnished to the men, insufficient in nutritive value, and is this perhaps the reason why these men prefer to have part of it commuted, instead of living on the same exclusively? For although the extra expense connected with the combined system of messing is small, it is still large enough to deserve consideration, and, I am sure, no sailorman, extravagant though he may be in some respects, would incur it if he did not *feel* that it was a necessary expense and money well invested. In order to answer the above question satisfactorily, we will now have to consult some of the results of the investigations of physiologists with regard to this subject.

We find that, for the purpose of maintaining life in a perfectly normal state, we need certain definite quantities of proteids, fats and carbohydrates mixed in certain proportions. Any human being fed exclusively on a fatty diet must finally perish from the want of nitrogenous food. In the same manner an individual fed exclusively on carbohydrates will inevitably incur the same risk.

After much experimentation and the most painstaking and laborious investigations on the part of both hygienists and physiologists, it is estimated by Voit that a laboring man, working from 9 to 10 hours a day and weighing on an average from 70 to 75 kilos, requires 118 grams of proteids, 56 grams of fat and 500 grams of carbohydrates.

The regular ship's ration, exclusive of hardtack, pickles, coffee and tea, gives us a nutritive value corresponding to 142 grams of proteids, 51 grams of fats and 398 grams of carbohydrates, a nutritive value which makes the ration superior as regards proteids, equal in fat-material and also superior in carbohydrates, providing we include the hardtack in the diet, as compared with the diet demanded by Voit for the laboring man of an average weight of 70 to 75 kilos. This estimate of Voit is the most accurate one attainable, and stands in almost perfect agreement with the estimates of all those authorities in scientific physiology and hygiene who have given this subject the most careful attention, excepting perhaps, minor differences as regards fats and carbohydrates.

It is considered that an allowance of 118 grams of proteids is a most generous quantity and that a man—our average man, for instance—can exist on considerably less than that amount. But we find on comparison that the nutritive value of our ration is equal to 142 grams in proteid material, or 24 grams more than is asked in the above generous allowance made by Voit.

The average man of Voit is one weighing from 70 to 75 kilos. Consulting our table of weights, we shall find that our average man only weighs, in round numbers, 65 kilos, or from 5 to 10 kilos less. It is perfectly well known that both the amount of mechanical work performed by a man, and, the amount of heat produced by him, stand in a certain definite relation to the weight of that man, and, consequently, also the amount of food which he consumes. *Caeteris paribus*, we may assume that our average man of 65 kilos needs less food than Voit's average man of 75 kilos. All the men on whom these observations were made belong to a gunnery class, undergoing instruction in the construction and usages of modern guns, which is, as the men have frequently confessed themselves, light work when compared with that which they would have to do in the average cruising ships, or with that which a laborer performs who is steadily at work for 9 to 10 hours a day. Consequently, our navy ration ought to be not only perfectly sufficient in its food-material, both quantitatively and qualitatively, but must be considered a generous allowance. And this fact also is freely admitted by the men themselves. The answer to my questions in this regard which I most frequently receive from the men is: It is enough, *but* . . . and there follows a pause.

Thus, in spite of this generous sufficiency as regards the quantity and quality of our navy ration, we must still admit the existence of a number of good and sufficient reasons on the part of the men for wishing to commute part of their rations.

Referring to Table III, item 5, we shall observe that under the combined system of messing, the daily food-supply per man is, on the average, equal to 181 grams in proteids, 110 grams in fats, and 495 grams in carbohydrates. This result of our calculation has been attained after making due allowance for all possible loss which might be incurred in the handling of the raw material of the different food-stuffs, and also after deducting the weight in bones and other waste from them. But allowing for the sake of argument, if for nothing else, even an additional loss of, say, 30 per cent., owing either to ignorance of cooks or to habits of wastefulness, we should still have left a diet consisting of 127 grams of proteids, 54 grams of fats, and 347 grams of carbohydrates; a diet more than equal in its proportionate nutritive value for our man of an average weight of 65 kilos and doing light work to that required by Voit for a man of 75 kilos in weight and working steadily for from 9 to 10 hours a day.

The most obvious conclusions that we can come to from the above method of reasoning are that the men do not get what they buy, or, if they get it, they receive it in such a form that they either cannot eat it, or, if they eat it, do not assimilate it. For if these men really got what they bought and properly assimilated it—converted it into flesh and blood—we should necessarily be led to expect a corresponding increase in their average weight, considering that their work was light and the demand for energy small.

Looking at the table of weights of the forty-two men, in which number our twenty men are included and all of which belong to the same gunnery class, practically all living under the same identical conditions and circumstances, we find, during the four months when their weight was taken at stated intervals, that they have made but an average increase of 0.4 kilos or not quite a pound. We can, therefore, only say that these men have merely held their own for a period of four months, and that in spite of their living during all this time as regular and orderly a life as men can live, and under the most favorable conditions not only of work but also as regards environment and climate.

The above-mentioned conclusions will find still greater support when the following calculations will have been considered:

It is well known that food-stuffs, when burned, develop different quantities of heat. Thus, the greatest amount of heat is developed by the fats, while the proteids and the carbohydrates are about equal in this respect. It is generally accepted as a well-established law in physiology, that the calorimetric values of the different articles of food determine also their respective physiological values as nutritive substances of the body.

Thus, one gram of fat produces 9.3, one gram of proteid and one gram of carbohydrate each 4.1 large calories. Whenever fats and carbohydrates are burned or oxidized within the body their calorimetric values are absolutely equal to their physiological values, because both of these substances are completely oxidized to form water and carbon dioxide. The physiological value of the proteids, on the other hand, remains behind the calorimetric value because proteids are not completely burned within the body; the remnant being urea. It has been estimated that the physiological value of the proteids is only from 72 to 78 per cent of their calorimetric value. Practically, one-third of the calorimetric value of proteids is deducted in the calculations for their physiological value in order to cover the loss both in urea and the small portion of nitrogenous substances lost in the fæces. According to Rubner, 100 grams of fat are isodynamic with 225 grams of proteids or 240 grams of carbohydrates respectively.

According to these figures, the amount of energy conveyed to our bodies in the form of food, providing the quantities ingested are known, becomes a matter of easy calculation. This energy may, furthermore, be expressed either in terms of heat-units or calories or in terms of mechanical work, since one *large* calory, or that amount of heat which is necessary to raise the temperature of one liter of water by one degree of C.°, corresponds to 425 units of meçhanical work; in other words, that amount of energy which is sufficient to raise 425 grams in weight to the height of one meter.

The food-stuffs with which we nourish our bodies must, then, first of all, supply the demands for the amounts of energy made upon us. A fully grown adult individual uses up, according to his occupation or the amount of work which he performs, from 2400 to 3000 large calories during twenty-four hours. Consequently, his diet must consist in food-material possessing *at least* a calorimetric value equal to that amount. More, of course, would be required by a growing body or by one under any great physical exertion.

The calorimetric value of the ration required by Voit for his average man, weighing from 70 to 75 kilos and working from 9 to 10 hours daily, equals 3055 calories. The corrected navy ration (item 8, Table III) amounts to 2696 calories. The combined ration (item 5, Table III) on which our twenty men have presumably subsisted, comes up to 3805 calories. The combined ration, less 30 per cent, which they probably subsisted on, in reality, gives us 2664 calories; and these estimates seem to agree with the actually observed facts as closely as could possibly be expected.*

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* It is not an easy task to determine, in a more direct manner, the work done by a man in 24 hours. This is, however, comparatively speaking, easy in the case of a man's walking or marching. In walking it is equal to 0.07 k. p, where k is the body-weight, p the number of steps taken, providing the walk was taken on a horizontal path. While marching, of course, the weight of the accouterments is to be added on to the body-weight; and, if any heights are climbed, these also must be added on to the results of the calculation.

TABLE IV.—WEIGHTS.

NAME.	AGE. Yrs.Mos.	DATE OF EXAMINATION.				GAIN.	LOSS.
		Nov. 23.	Dec. 11.	Jan. 11.	Feb. 25.		
Nolan, M. J......	24, 7	62.7	61.3	64.1	64.1	1.4	....
Kohler, F. J.....	29, 4	67.3	67.5	67.7	66.8	....	0.5
Damon, E. J.....	25, 8	67.7	67.0	67.0	67.0	....	0.7
Danielson, C.....	25, 5	62.7	62.3	64.1	64.1	1.4	....
Wolf, W. F......	25, 1	63.6	62.3	63.2	64.5	0.9	....
Stickney, F. G...	30, 2	62.7	65.2	65.0	65.0	2.3	....
Harmer, W. P...	24, 8	58.6	60.6	61.3	62.2	3.6	....
Clark, B. H......	25, 11	62.7	62.7	62.2	61.3	....	1.4
McMullen, E. B..	23, 11	59.3	59.2	62.3	61.8	2.5	....
Fox, R. W.......	23, 10	68.0	69.1	67.0	70.0	2.0	....
Johnson, C......	33, 8	75.2	72.7	73.2	72.3	....	2.9
Frederickson, F..	32, 4	59.5	60.2	60.2	60.9	1.4	....
McCrea, F.......	28, 1	65.0	64.5	66.4	65.9	0.9	....
Ryan, D.........	26, 7	62.3	63.2	63.2	64.1	1.8	....
Sherwin, E......	20, 10	69.7	71.3	71.3	74.1	4.4	....
Wade, C.........	26, 0	53.4	52.3	53.6	52.7	....	0.7
McQuade, F.....	30, 4	61.1	63.2	63.6	59.1	....	2.0
Smith, B........	24, 1	53.0	53.0	53.0	53.2	0.2	....
Shepley, B. H....	23, 0	55.4	55.4	56.8	55.9	0.5	....
Hansen, H.......	29, 11	71.8	71.8	73.4	71.8	....	....
Heyden, J.......	26, 2	69.1	69.5	71.8	69.0	....	0.1
Brownlee, W. J..	25, 8	65.4	66.8	66.8	65.4	....	....
Hurdle, O. F.....	23, 3	68.0	67.0	67.0	68.2	0.2	....
Pollard, G. A....	26, 2	69.1	69.1	69.8	67.3	....	1.8
Hicks, C. T......	38, 6	67.3	69.8	71.0	70.0	2.7	....
Doulon, P.......	32, 11	68.2	70.0	69.5	68.6	0.4	....
Creelman, N. J...	23, 3	59.5	59.1	60.4	59.0	....	0.5
McNally, F. J....	26, 8	64.0	63.4	62.5	63.6	....	0.4
McQuay, S. C....	28, 10	61.6	59.5	60.4	61.3	....	0.3
Svenson, A. J....	23, 1	62.3	61.8	62.7	63.6	1.3	....
Crone, C........	24, 7	58.0	55.0	58.0	55.0	....	3.0
Herbert, P.......	28, 0	66.0	66.6	67.5	66.0	....	....
Linden, K. F.....	30, 1	63.6	63.2	64.8	64.1	0.5	....
Bottcher, R. D...	23, 6	63.6	62.0	64.5	64.1	0.5	....
Jacobus, F. W...	23, 2	67.5	66.1	66.8	67.0	....	0.5
Mills, R. H......	27, 1	67.5	70.0	71.8	68.1	0.6	....
Kraczewski, B...	32, 2	80.6	78.2	81.1	79.0	....	1.6
Brewster, C.....	29, 11	64.5	65.9	67.3	66.8	2.3	....
Pederson, C. V...	25, 7	65.0	65.0	65.0	64.1	....	0.9
Kennedy, J. M...	23, 9	57.3	59.1	60.4	60.4	3.1	....
Lemieux, S......	32, 3	60.0	59.1	59.1	56.8	....	3.2
Morey, A. L.....	23, 2	54.1	54.1	56.8	57.3	3.2	....
Average	27, 5	64.0	63.9	64.8	64.4	0.9	0.5

In other words, the demand on the men's energy amounted on an average to 2664 calories, and they took just sufficient food to supply this demand, and the rest, if there was any, was wasted for reasons of poor cooking and of serving the food in an uninviting manner.

To summarize, the following conclusions seem to be justified by the above investigations, namely:

1. Consolidate the number of small messes on board ship into one general mess.
2. Train your cooks in the art of good and economic cooking and supervise their work on board ship.
3. Commute all ships' rations whenever communication with the markets on shore can be established, as recommended in the "consolidated mess system."
4. Relegate the present ships' ration to the function of an emergency or "iron ration," to be used only in cases of necessity, or whenever communication with the markets on shore is out of the question for good and sufficient reasons.
5. Authorize a war ration.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A SCHEME FOR A FRENCH NAVAL WAR COLLEGE,

With a Report

By Count de Treveneuc, Committee of Naval Affairs.

Admission to the War College is to be by competitive examination, open to lieutenants of the senior grade only; examination to be held by a board of naval officers. The course to be two years; the first year studying at Toulon, the second in a special practice squadron. At the end of the first year the officers that merit the second year's course go to sea in the practise-ships. The remainder, if they have passed their examinations, get first choice on all commands not specially reserved to the officers that successfully complete the entire course. The privileges extended to the officers completing the full course are: (1) first in selection for duty on staff of flag-officers, ashore or afloat; (2) at least one-third of the commands shall be reserved for them.

The officers granting these diplomas to consist of the inspector-general, the commandant of the school, the commander-in-chief of the home station, and two officers specially detailed.

Many excellent criticisms upon the needs of the service are brought out, which are equally applicable to our own, and well worthy of consideration, especially in the matter of a construction policy.—The Editor.

Those of you who, desirous of having your personal opinions on maritime questions corroborated by professional men, have addressed yourselves to naval officers, have all, doubtless, been equally impressed with the diversity of replies made to each of the questions submitted.

Even when conferring with the most eminent persons, inquiries having been limited to a request for a general opinion on the naval warfare of the future, the replies received have been, most frequently, but uncertain—sometimes contradictory—affirmations.

It may be even that the decidedly alarming admission was made that a definite opinion on this question did not exist; that it could not exist, because of the lack of sufficient data; that the naval war of the future would produce entirely novel military situations; and that neither its strategy nor its tactics could be foretold.

And, furthermore, to confirm these contradictions and negations, it is only necessary to examine professional publications of the highest standing or to read over the records of parliamentary discussions and to note the statements of the various ministers who succeed each other—alas, too frequently!—at the head of our two military departments.

Yet, at the same time, it is unity of ideas—the adoption of fixed principles—which will appear as the chief and decisive factor of success in modern warfare, at sea as well as on land.

In fact, gentlemen, modern warfare has definitely assumed, for an armed nation, an entirely new and peculiar aspect.

The long and methodical armed encounters of the 18th century were followed by the irresistible and crushing blows of the Napoleonic campaigns. The Emperor expressed in two words the secret of his astounding achievements: "Masses and Movement."

Since that time, the masses and their movement have been increased nearly tenfold.

On land, this is the instantaneous mobilization of an entire nation, the rapid organization of bodies hitherto not existing and the concentration of all the forces for the purpose of striking a decisive blow and to prevent the adversary from taking the offensive.

At sea, this means blows even quicker and more crushing; this is the mobilization, within the very hour, of the organized forces, promptly followed by that of all other available material.

This gigantic effort will be required immediately upon the assembling of elements which, for the greater part, have hitherto been, to a certain degree, strangers to one another. The leaders will not know their subordinates; many will occupy a position, on the very morning of the battle, with which they were unfamiliar the day before; yet, the victory depends upon the immediate concentration of all the forces. The commander-in-chief's purpose must be understood, nay, even anticipated by all officers, of whatever grade they may be, without a preliminary understanding or instructions given at the eleventh hour.

The time is no longer when one could expect the victory in battle to rest upon a single brilliant stroke of genius. The war of the future must be prepared long beforehand and the details of its material thoroughly tested. The brilliant inspiration of the last moment must be supported by the weight of common opinion. The patient and methodical labor of Germany, adjusting piece by piece and regulating during a half century all the parts of the formidable machinery which crushed us, furnishes a striking example which should suffice us.

With the advent of modern warfare, the old saying, "The art of war is only learned in war," has lost its value. No, the war of yesterday is no longer the school of the war of to-morrow—that school must be found in the armed peace of to-day. No, the day no longer exists when a Duquesne, a Tourville or a Suffren could, during interminable cruises, inure his crews, instruct his subordinates and instruct himself, paving the way by brilliant feats of arms for victories even more astounding. The blows to be struck in the wars to come must be decisive. Those who are to strike them should long before be prepared for their several duties.

And then, the theaters of operations are enlarged and extended; the means for carrying on war are multiplied and infinitely varied.

The commander-in-chief can no longer personally superintend the regulation of details as opportunity offers. Every one must be at his post, ready to carry out his part at a mere signal of execution.

Hence, the *raison d'être* for a settled policy appears in still another form—perhaps its highest—that of the *initiative.*

Is it rash to imagine one of those great encounters at sea, where the elements of warfare, of the most diversified types—ships of all classes, fortifications, submarine defenses, fixed or mobile—are assembled for a supreme effort, opposed to each other at the same instant, on the same field of battle, and finally, for numerous reasons, failing of concerted action under the direction of a single mind?

And yet, what other bond between them can we imagine but a common purpose, known to all, understood by all, and carried out by all in the same manner?

If all these considerations, gentlemen, of a nature concerning purely morale and method in military affairs, are applicable as well to the details of land as to those of naval warfare, there appears in the consideration of the latter yet another element which emphasizes with particular force the need of an established policy. I speak of the importance of a *materiel* which will be of great importance in the future and which weighs heavily on the finances of the country.

Is it not obvious that the *materiel* of the navy should be governed by our conception of the strategy of the war in which the same is to be used—that it is rather the means which should be regulated by the end to be attained than the end by the means—that it is folly to begin the construction of vessels, each of which represents millions of accumulated capital, if it is not known beforehand for what purpose and in what manner they are to be employed?

In a word, it would seem that it is not the *materiel* which should regulate the character of the warfare to be waged, but that the character of the warfare should regulate the design of the *materiel* to be constructed. From which it follows, as principal corollary, that the constructor should not fix the design of the vessel for the (sea-going) officer, but that, more properly, the latter should require of the constructor a certain type of ship, furnishing him with the data of the problem to be solved—the conditions which the ship is to fulfill.

It has often been repeated that the strength of a nation's fleet should be in accordance with its foreign policy. This idea is more completely expressed by saying also that a country should have a fleet in accordance with its strategic conceptions.

Strategy is intimately connected with policy, of which it is the active agent.

One of our honorable colleagues, M. Lockroy, has expressed this idea very forcibly in his work on our navy.

Speaking of the diversity of types produced at our dockyards, he says: "It is probably the search after the best which has brought our constructors to this fatal variety of type; but it would seem that imagination, fancy only, has governed these designs as a whole—one searches in vain for a recognized plan, a governing idea—something tending to show that there has been kept in mind a certain objective, that certain eventualities have been foreseen, that in a certain way, the manifold problems of war have been understood and solved."

Alas! the confusion of types proves forcibly the confusion of ideas; the former is a striking manifestation of the latter. And whence could light be shed upon this chaos, since all our maritime institutions still lack a center of intellectual activity?

Let us follow, step by step, the normal career of our naval officers and let us analyze its successive stages. To begin with, an elementary education frightfully hurried and overdone, the rapid assimilation of a most complex course of study, the intellectual driving which the limit of age for entrance into the naval school at Brest makes practically inevitable. Next, two years of assiduous study in the limited field on board the Borde. Then, as a valuable correction and fully necessary, a practise-cruise which comes as a blessed relief to young brains too long overcharged. From time to time, regular and frequently recurring examinations with all their nervous strain. Later comes the reaction: the scattering to the four winds of the old text-books and their contents, the joy of forgetting after having learned too much. At this time, there begins for the young naval officer the experience of life and of the daily practice of his profession, infinitely absorbing, irresistibly attractive. Each of the details of this delightful career is, so to speak, an entity capable of occupying the entire active period of a man's life.

One looks at them, necessarily, as through a microscope; and one following upon the other, each inevitably absorbs, to its own benefit, the faculties of the most robust.

Cruises alternate with periods of other duty, and the years pass by. The long monotony of the grade of lieutenant is interrupted, for some officers, by the pursuit of some specialty. There, also, a detail predominates—the small-arm, the gun, or the torpedo—which absorbs all the officer's energy to its own profit. Some are attracted by scientific studies and occupy their time thus. In time, the officer attains to command. The command is the ambition of every seaman who is worthy of his profession. And how enthusiastic, indeed, are these commanders, whoever they may be, however modest they may be; what a satisfaction, this uniting in the same hands, at the age when physical activity wanes, of authority and responsibility! But also, how absorbing—nay, hypnotizing! And yet, each of these commanders, though he be the commander of the most powerful single vessel, is but an item in the whole organization of warfare.

Again details absorb all the vital force, to the detriment of the whole. And each individual, feeling the presence of a superior in rank, who is immediately responsible therefor, considers that the whole does not concern him, takes no interest in it, and leaves it to him who is officially responsible. And thus we pass on from grade to grade, from one period to another; we pass from the torpedo-boat to the armor-clad, to the division and the squadron, always on the search for a period in the life of an officer when the whole may be taken up and studied, but this period is never found. This is of supreme importance to the national defense; it is this, gentlemen, which your committee has attempted to definitely provide for in the bill which it has the honor to submit for your consideration.

The object of this bill is to supply the Navy Department with a school for study of the higher branches of the art of war, analogous, in principle at least, to that higher military school which, in uniting the army on one definitely fixed policy, has already achieved such remarkable results. Since the opening of this session, the committee, impressed with the importance of the question, has delegated a subcommittee to study the most practicable way in which this school can be established and what should be its functions in order that it may accomplish all that may reasonably be expected of it.

The subcommittee had already drawn up its conclusions when, upon the appointment to the portfolio of the marine, of our colleague, the Hon. M. Lockroy, our proposals were realized, essentially at least, by a decree.

M. Lockroy was pleased to appear before the subcommittee and explain to them the origin of the decree by which the school was established, and in accordance with the provisions of which it was to exist during the fiscal year 1895-1896.

The discussions which then occurred have since been reproduced in his book "La Marine de guerre." They are, furthermore, summed up in the decree signed by him.

The working of the school, as it had been established by the decree of December 27, 1895, fulfilled, to a great degree, the general requirements of the committee's plan. The subcommittee witheld the statement of its opinions, considering it advisable to await the results of the enterprise which had been undertaken. These results were very remarkable, according to the report of the inspector-general, whose duty it was to give an opinion on them. In the meantime, there was a change in the Ministry of Marine and, on the 13th of October, 1896, the new incumbent, Admiral Besnard, issued a decree which effected throughout radical changes in the organization previously established.

True, the idea still existed of a superior school, but its execution was on altogether different lines. An entirely new institution was created. This is in existence at the present time, and it would seem, should also give most interesting results, though of an entirely different nature from those of its predecessor.

The vicissitudes through which the "Ecole superieure de marine" passed shortly after its establishment have impelled your committee to hasten its labors and to establish its conceptions by means of legislation. It would appear to be necessary that its existence be placed under the safe-keeping of the law.

The object of the school is twofold: it is, primarily, to propagate a common doctrine among our naval officers. This, we have attempted to show, is an imperative necessity, indisputable —imposed by modern warfare—it is the condition upon which depends the future existence or extinction of our military power both on sea and on land. The doctrine should originate in high places. Its creation should devolve upon those in supreme command: it is for the school to diffuse it. At the same time, the doctrine of defining it and of putting it to practical test, in order to verify its propositions. It is, *par excellence*, a *technical section* of tactics and strategy, always at the disposition of the chief of the general staff, under whose authority a subsequent article will place it.

Its second object—and this is not at all its least important duty—is to create commanders for our navy, to educate for it general officers. We use here the expression "general" in its absolute sense.

An officer invested with command should be a general officer in the etymological meaning of the word. He should rise above the consideration of all details, in order to grasp them as a whole; he should be familiar with the working of the various departments, those which he personally directs, as well as those which come more or less directly under his general supervision. It is in his hands that all the essential elements of warfare should be combined.

Without these elements, all is inutility, superfluity, waste of effort, time and money. In any case, the commander-in-chief should not be under the influence of subordinates—for him to command, for them to obey.

Orders given should be capable of execution; to this end, it is necessary that he from whom they emanate should understand the requirements, the means of action, and the precise limits of execution of those to whom they are addressed. The efficiency of the command is a function of this synthesis, from which springs harmony of action. Failing this, there is a dispersion of effort, incoherence, and impotence.

In time of peace, as in time of war, the commander should be capable of exercising command before he is actually invested with it. The grave responsibility of exercising command forbids its use as a means of educating the officer entrusted with it.

The prestige of the commander must be preserved. "Active" discipline, according to Dragomiroff the only useful one, can be inspired only by the confidence which the subordinate has in the ability of his chief.

The "Superior school of the Navy" should be the nursery for high command.

Shall admission to the school be based upon a competition, or upon the opinions of a board of classification which is to decide according to the previous record of the officer? An almost unanimous decision was arrived at in favor of the principle of competition.

Competition has seemed to us to be the only perfect method—at any rate, as nearly perfect as possible—of assuring impartiality. Your Committee has judged it to be absolutely necessary to dispel the mere semblance of favoritism, to reduce to a minimum the chances of an incorrect decision in a matter which may have a deciding influence on the futures of the officers of our ships. We are of the opinion that any kind of military career already offers, of itself, so many doors necessarily open to outside influences that, at an important point in this career, the lawmakers should seek to insure a rigorously impartial trial.

It has, furthermore, appeared to us that a competition for admission would be a singularly powerful incentive to study during all the earlier years of the naval officer's career.

Upon graduating from the school at Brest, all our young cadets well know that, at a date which they can anticipate, they will be obliged to show what they have accomplished, and that their future career will, in a large measure, depend upon this test.

After having learned how to work, they will apply themselves resolutely to the task at the age when study comes the easiest and gives the best results, but is, at the same time, the least in favor.

After several years of these individual efforts, which alone can develop the resources of the mind, each generation will contribute the result of the combined efforts of its individual members to a great intellectual center, from which will emanate that unity of doctrine, without which all is wasted in modern warfare.

Having once established the competition, it became necessary to place it at that point in an officer's career when it would produce its maximum beneficial effect.

It was important that certain conditions should be clearly defined, so that there should be provided for, at the same time, a maturity of intellect in the candidates and an intellectual suppleness which would still enable them to grapple, at times, with difficult problems.

It was also of prime importance that each officer should have given evidence, before his entrance into the "Superior School," of his total value from a military standpoint—as much from the point of view of the practise of his profession as from the point of view of his aptitude for command.

There are still other considerations in fixing the limit of age. In fine, it is essential that the date of graduation from the School should be sufficiently near the date of promotion to the higher grade, that the intellectual benefits should bear fruit at this time and that the ideas acquired shall not have become obsolete. At the same time, these doctrines should be disseminated among those of the middle of the list—among minds young enough to be malleable—of the grade of lieutenant.

All of these various, and at times, conflicting conditions appear to us to be satisfied, as nearly as possible, by selecting senior lieutenants.

Several members of the committee considered that the possession of a certificate in some specialty should be inserted as one of the conditions of the competition. The majority, however, disagreed, considering that the good which results therefrom would, in many cases, fail to compensate for the practical difficulties inherent in the forced introduction into the officer's career of another year of study. It is, above all things, important not to keep our young officers from those distant cruises, the hard practical experiences of which are unquestionably one of the best tests of the physical and moral vigor of our seamen. Nevertheless, certain advantages might, very properly, be given to those candidates having certificates at the time of the competition for admission.

The Committee has taken under consideration the form to be given to this competition. This, without doubt, is a delicate question.

The Subcommittee endeavored to accomplish this by fixing specifically the nature of the tests.

The Committee considered the latter to be an encroachment upon the executive authority and has left the matter to be regulated by ministerial decrees.

But it has always been of the unanimous opinion that the professional qualifications of officers should be taken into consideration. It has caused to be inserted in the proposed legislation the provision that a mark of general aptitude, based upon his previous service, be assigned to each candidate by the Board of Classification.

The examinations for admission should be largely open; every officer, whatever may be the fortune of his seafaring life, should, at several times during his career, have an opportunity to take part in the competition. Every precaution will be taken to insure the fairness of the tests.

The subjects for compositions, selected under the direction of the Chief of the General Staff, are to be sent, sealed, to the various places where examinations are held, the results being afterwards collected by a special board charged with the duty of considering them—in absolute ignorance of the names of the authors.

The length of the course has been fixed at two years. It has appeared to us, in the light of experience acquired, that one year has been clearly shown to be insufficient to satisfy the conditions imposed. Furthermore, the division of the course into two parts, one devoted to historical study and the other to practical applications thereof, imperatively demanded a two years' course, under pain of intellectual overcrowding and incomplete assimilation.

This division of the program is the capital and characteristic feature of the bill which is submitted to you; it is this which, in a measure, distinguishes the Committee's conception of the subject from the various ideas which have been tried.

The decree of December 27, 1895, established the school on board of three cruisers. Officers were on board ship during the entire course. These conditions were necessitated by the short space of time at disposal.

The decree of 1896, on the other hand, followed an entirely different view; the school was established on shore, at Paris, thus devoting the greater part of the course to theoretical study. The practical exercises were, consequently, limited to two months at sea in squadron, during which time the student-officers, scattered among the various ships of the fleet, took part in maneuvers which were, no doubt, very interesting, but which might frequently bear no relation whatever to the theoretical principles taught at the school.

We beg leave to disagree at this point, in order to refute, from now on, a theory which is in vogue and which seems to us dangerous—the theory which sets it forth as a principle that the fleet is the only proper school of tactics for the navy.

The fleet is not a school, but a fighting force of the first rank, where each person is at his battle-station, his mind absorbed by the heavy weight of his personal responsibility and the multifarious details of the duty with which he is charged.

The fleet is no more a school than the sixth corps in the Vosges or the second division of cavalry at Limeville. Instruction is carried on there, to be sure, and professional knowledge increased, because at each step in the ladder of rank and command, the senior is the natural instructor of those who are under his immediate command; but this is done only according to strictly, one might say officially, defined lines, and beyond which it would be hazardous to authorize experiments, however instructive these might otherwise be.

On each ship, the divisional officer is at his guns, the torpedo-officer at his torpedoes; and as we have stated in our general survey of the subject, it is attention to these details which, except when he is on watch, make up the officer's duty. It will be urged, no doubt, that officers should be informed of the scheme and purpose of each maneuver and that, upon the completion of the same, these officers should all be assembled by the admiral, for the purpose of a general *critique*. Undoubtedly this is desirable; but how difficult this will be to accomplish in practise! And furthermore, would it not show a poor knowledge of human nature to fail to take into account the lack of interest of all persons in that which does not immediately concern themselves? At the most, the fleet is a school where the commander-in-chief and his personal staff may gain instruction; besides, it would be dangerous to carry such a doctrine too far. In any case, the fleet cannot be a school for younger officers.

To return to our subject after this digression—a little lengthy, perhaps, but which has seemed to us to be necessary—we will state that the author of the decree of 1895, as well as the one of the decree of 1896, has appeared to us to have permitted himself to be governed by financial consideration, to which your Committee has not considered it necessary to pay attention in the establishment of an institution which it considers indispensable to our national defense. Besides, the expense will not be great.

We have found ourselves unanimously agreed, as we have said before, on the necessity of making the "Superior School of the Navy" a school of advanced military studies. Its object should be to take officers accustomed to the daily practice of their profession, in order to make of them experts in the art of war in the fullest sense of the word. Its immediate purpose is first to develop competent staff-officers; to surround the commander-in-chief by an atmosphere of intellectuality, in which he will feel at ease, undisturbed by minor cares, and sure of being understood and ably seconded.

This, of itself, will create a place especially adapted where, perhaps, the leaders of the future will be developed.

And so, believing that such a result could only be obtained at the price of considerable intellectual effort, we have deemed it important, above all, to give the officers the best material facilities for work. Now, there is no doubt that the life on board ship fails to satisfy these requirements.

We considered it essential that a portion of the work of the course should be purely mental. At the same time, your Committee concluded that, after a sojourn on shore devoted entirely to theoretical study, the practical application of the theories taught, the verification of the conclusions arrived at, would become a necessary complement of the instruction of the school.

It is with this end in view that the second year of the course has been set apart for a period of application on board of armed vessels, organized in a division of instruction, and forming the natural sequel to the course of study of the first year.

We have already shown that a fleet could not, in any case, be a school, not even a school of application. This character could only be developed in a naval force especially set apart for this purpose. That, however, would not prevent it, as we shall see by what follows, from drawing lessons from certain maneuvers of the entire squadron which could not be carried out by a single division.

The period on shore is, in effect, based upon the necessity for the dissemination of a common doctrine. This applies, in principle, to all officers of normal value, it is to be desired that all officers may profit thereby and should it become necessary to debar a large number therefrom, it would be because the exigencies of the service interfered to limit the number of admissions. We hope, nevertheless, that the number of those selected to benefit by the instruction given during the first year will be considerable.

The period of application, on the contrary, which is to be the real school of command, should be reserved for a carefully selected few. The selection of these officers will be made during the first year's course, and is to be the result of numerous and almost constant tests.

The competition resulting from this method will possess a character of absolute fairness; it will give, unquestionably, the exact value of the officer and will not rest upon the sometimes doubtful criterion of a single examination.

During the past few years, our naval institutions have often been severely criticised; there has been talk of reforms to be effected throughout. No one denies any longer the advisability of modifying in certain respects the present organization which perhaps fails to meet, in every way, the requirements of a new situation. But before thinking of reform, we believe it to be, first of all, necessary to supply that which is lacking and which it would be supremely imprudent to dispense with any longer.

Our navy possesses incomparable elements of strength. Recruiting our crews from among our splendid maritime population, we are assured inexhaustible resources with which no other nation can think of competing. Our officers are, individually, the best in the world, as much by reason of the dignity of their character as by their professional worth and their general education. Our ardent patriotism has enabled us to make the most strenuous financial exertions.

Generally speaking, the raw material which we have at our disposal is of the first order. It is important that this should be developed in such a way that it will yield the best results. We should, without further delay, assemble these too often divergent and widely scattered forces, uniting them in a homogeneous whole, that they may cooperate to the best advantage in the preparation for war. The creation of an intelligent center for the navy will mark the first step towards the supreme objective.

PROFESSIONAL NOTES.

ELECTRIC POWER FOR MARINE PROPULSION.

The rapid development of the applications of electricity to all kinds of purposes on land, ought not to be allowed to obscure the peculiar fitness of the same agent for the propulsion of certain classes of vessels. Mr. T. C. Child calls attention to this fact in an article in the *Engineering Magazine*, and advocates the use of accumulators for the propulsion of ferry-boats and torpedo-boats. The great weight and small storage capacity of accumulators are far less serious disadvantages afloat than in the case of vehicles on land, although a complete electric-launch equipment weighs about 250 pounds per horse-power, with an endurance of one hour—about four times as much as a steam-power plant for the same duty; while other considerations arise which may in some cases completely turn the scale in favor of electricity. Where a number of ferry-boats are employed to maintain a regular service, by charging the batteries at constant pressure at the termini, the generating plant may be kept at work under the best conditions, and an important economy effected; while in the case of torpedo-boats, the necessity of speed, silence and delicacy of control makes electricity the motive power *par excellence*. The application of electricity to the propulsion of canal boats has been developed to some extent in France, but is still in a purely experimental stage; in view of our high railway rates, and the great length of canals lying almost unused in this country, the importance of a practical solution of this problem can hardly be exaggerated.—*The Steamship.*

LIFEBUOY WITH ELECTRIC SIGNAL LAMP.

The greater part of loss of life in connection with shipwrecks at night is due to the inability of the victims to get hold of an object which will keep them afloat till the lifeboats can reach the place of the disaster. The lifebuoy under notice, which is considered to supply an excellent means to cope with the difficulty referred to, consists of a large cork ring which is covered with stout sail cloth, and of an electric lantern which is mounted on a tubular pole. The incandescent lamps in the lantern receive their energy from an electric accumulator placed in a strong metal case at the foot of the lamp pole. This lantern is placed almost in the center of the cork ring and connected to it by means of a universal joint which enables the lantern to remain in an upright position while the ring is pitched into all possible positions by the waves. The reason for not placing the lantern exactly in the center of the cork ring is to create a tendency of the latter to fold into a plane with the crossbar and to fix readily to the side of vessels. The pole of the lantern passes through a crossbar which is connected with the switch of the lantern. A spiral spring is inserted between this crossbar and the lantern head and tends to put the switch "on." It is, however, prevented from doing so as long as the whole apparatus is suspended by its crossbar, as the weight of the former suffices to compress the spiral springs. But the lights may be tested while the apparatus rests on its support, and, as it leaves it and gets immersed in the water, the spring acts and the light is switched on. The cork ring is large enough to accommodate one or two people inside, and a number of rope loops are provided for others to cling to it. The accumulator is of Zerning's metalloid type, with which shifting or crumbling of the plates is said to be impossible as the interstices are solidly filled up with a substance that retains the electrolyte and prevents spilling under the most severe conditions the battery can be put to. On the other hand, the electrolyte is readily given off to the plates for the purposes of the electro-chemical action while the light is switched on. The conditions which this battery has to fulfil differ materially from those under which accumulators have usually to work, as this accumulator has only to serve for a very few discharges, but it must be able to retain its charges for a very long period. Zerning's accumulator is claimed to fulfil these conditions to a very high degree. The top of the gun-metal vessel in which it is rigidly placed has a screwed-on cover for inspection and for replenishing the electrolyte. The stem of the lantern is made of a solid drawn steel tube which offers ample protection for the leads which connect the accumulator with the lamp. These leads pass first through stuffing boxes in the cover of the accumulator before they enter the tube, the lower part of which is filled up with a suitable non-conducting material as an additional precaution. The lantern proper consists of a stout spherical glass vessel similar to those used for nautical purposes, and fitted on top and bottom with watertight gun-metal covers. Below the top cover an ebonite plate is provided which carries the terminals of the leads from the accumulator, and also two incandescent lamps with their terminals. On the bottom cover is mounted an electro-magnetic switch which throws the second lamp into circuit when the first gets unserviceable by any cause whatever. Extensive trials have been made with this electric safety buoy by independent experts, who report very favorably about it; and amongst those who have taken it up are the German Imperial Navy, who have bought a number for further trials.—*The Steamship.*

ELECTRICITY ON BOARD SHIPS.*

By S. Dana Greene.

The modern first-class battleship requires about 2000 indicated horse-power to drive all the auxiliaries at full load, and the first-class cruiser about 1200 indicated horse-power. These auxiliaries, however, are never all in use at the same time, using maximum power, and it can be assumed that about one-half these amounts (*i. e.*, 1000 indicated horse-power and 600 indicated horse-power) will be required at one time. They are scattered all over the ship, from the anchor hoist forward to the steering engine aft, and from the deck winches and boat cranes on the spar deck to the bilge and fire pumps in the engine- and fire-rooms, 30 or 40 feet below. Some of them, such as condenser, air, circulating, feed, bilge, and fire pumps and fire-room blowers, are necessarily located within the engine- and boiler-room compartments, where the temperatures are always high, and where steam, oil, water and coal-dust are always present in greater or less quantities. Others, located on the spar deck, are exposed to salt water and air and to the varying conditions of sea and weather.

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* Synopsis of paper read before the American Institute of Electrical Engineers.

With these scattered locations it is obvious that power, generated at a central point, must be distributed throughout the ship. For this purpose there can be used either steam, hydraulics, compressed air or electricity. Hydraulics and compressed air not only have a low efficiency of conversion (from steam) but it is difficult to prevent leaks, freezing, bursting of pipes, etc. They have both been tried to a limited extent, and both found wanting in service. This leaves steam and electricity as the two remaining systems of distribution from which to choose. As, between the two, steam has the following disadvantages:

First. Danger to life. The bursting of a steam pipe, whether in or out of a fight, is a serious matter and likely to disable any of the crew who are in the compartment where the accident occurs. It has been abundantly proven in our civil war that men will not stand up against steam or hot water, when they will face shot and shell without flinching. Many of our vessels operating in inland waters during that war had several lines of hose coupled to a hot-water tank and led out every night to guard against boat attacks. These hose were successful on more than one occasion in repelling boarding parties. While the main steam leads fore and aft can be run below the protective deck or behind the armor belt, vertical branches must run to all auxiliaries on the upper decks, and many of these must be used in action. The effect of a steam pipe carrying 100 pounds pressure bursting or being shot away in a compartment where there may be thirty or forty men at the guns or passing ammunition, would undoubtedly be to kill or disable every man in the neighborhood and demoralize thoroughly that part of the ship. On the other hand, if a wire is shot away, one or more auxiliaries may be disabled, but no one is injured; furthermore, the wire presents a much smaller target than a steam pipe, and is, therefore, less liable to injury from shot. It is always a difficult matter, too, to keep steam and exhaust pipes tight and to prevent leaks at the joints and at watertight bulkheads.

Second. Injurious heating of living quarters. Steam and exhaust pipes must necessarily run to every auxiliary, and some of the latter, such as the ice machine, anchor hoist, steering engine, ventilators, etc., are in the officers' and men's quarters, or the pipes leading to them must pass through these quarters. The heat of the pipes and engines not only makes the quarters uncomfortable, but it is impossible to prevent more or less oil and dirt around the auxiliaries. In the tropics the heat is often so great that the officers and men cannot sleep below at all. This was the case on a number of our vessels operating in Cuban waters last summer.

Third. Efficiency. Here the contrast is very striking in favor of electricity, surprisingly so to one who has not seen the actual economy figures in steam auxiliaries.

There remain the two important factors of simplicity and reliability to be considered. No one who has had experience with the modern well-designed and well-insulated carbon-brush generator or motor can have any doubt as to its greater simplicity as compared with the steam engine. There are no joints to keep tight, no nuts or bolts to set up, no packing to renew, no cylinders to cut, and only two self-oiling bearings, as compared with a dozen or more oil cups on an engine. In fact, it is difficult to imagine a simpler piece of machinery than the modern dynamo. It seems like a return to elementary principles to discuss such a point; and yet many men aboard ship imagine the dynamo a most complicated affair, simply because they know nothing about electricity and think everything connected with it is mysterious and complex. This feeling is not confined to seafaring men, as we all know.

The question of reliability is a vital one, for no matter what the advantages with respect to safety, economy and simplicity may be, if the electric auxiliary cannot be relied upon at any and all times to do its work it is a failure and must be discarded. It must not only be able to work well under normal and favorable conditions, but it must also be able to stand a certain amount of abuse and neglect. Stress of weather and other conditions particularly during a war, sometimes play havoc with the established routine of a ship, and the sailors' tools must not only be sound; they must be hardy. The normal conditions aboard ship are not favorable to ordinary electrical apparatus, but this simply means that apparatus for such work must be specially designed and built to meet these conditions. The ordinary motor would not last long under a street car; nevertheless thousands of car motors are built and sold every year which run day in and day out with a remarkable low maintenance account. Similarly, apparatus for ship work must be specially insulated, a larger margin of capacity must be allowed, and in exposed places it must be thoroughly enclosed. Several years ago an English manufacturer asked permission to install an electric deck winch on the spar deck of a new cruiser fitting out at Portsmouth. When the captain, who was superintending the fitting out of the ship, saw it he gave orders to have the deck hose turned on the motor for ten minutes, and then to operate the winch. The manufacturer protested, and said that the motor was not intended to be abused in that way. "Then take it off the ship," said the captain, "for I cannot guarantee that we will ship no seas during our cruise, and I want that winch ready for service whether we ship seas or not." The captain was quite right, the motor was taken off, and a "rough and ready" steam motor substituted.

Experience alone is the final test of reliability, and, fortunately, we have some experience in our navy on which to rely. During the late war all of our regular war vessels were fitted with electric lighting plants and many of the larger ships were supplied as well with certain electric auxiliaries, such as ventilating fans and ammunition hoists. Two of the Brooklyn's turrets were controlled by steam motors and two by electric motors. So far as I have been able to learn from both official and unofficial sources, all the electrical apparatus on these ships stood the supreme tests of battle admirably, and the officers of the Brooklyn are enthusiastic over the performance of the electrically controlled turrets. They report that with respect to ease of manipulation and fineness of control there is no comparison, but rather a contrast. This is high praise from competent authority, for the officers referred to had actual command of the turrets in battle, and their judgment is not only unprejudiced and impartial—it is final and conclusive.

It is hardly necessary to say that electric machinery, to be reliable, must have reasonable care and attention from men who know something about it. The same is true of any machinery, and it is bad policy, as well as untrue, to say, as is sometimes said by those who should know better, that an electric motor requires no attention. Cleanliness is very necessary and may be considered as a first essential to successful operation. It is astonishing to see how little has to be done to an electric motor if it is kept scrupulously clean; but this cleaning must be regular and intelligent. From what has been said it may safely be affirmed that electric machinery can be made as reliable on shipboard as any other machinery, and with this in mind we can turn to the question of efficiency, including weight of plant and first cost.

There has been very little data published on the performance of ship auxiliaries, but a valuable contribution to the subject appeared in the February (1898) number of the *Journal of the American Society of Naval Engineers*, by Passed Assistant Engineer W. W. White, United States Navy, entitled " Steam Consumption of the Main and Auxiliary Machinery of the United States Cruiser Minneapolis." This vessel, as is generally known, is a first-class protected cruiser, of about 7500 tons displacement, with three screws (each operated by its own engine) and a trial speed of over 23 knots per hour. She represents the highest type of her class, and is in every way a credit to her designers and builders. She has between thirty and forty steam auxiliaries, and more than one hundred and fifty separate steam cylinders. Her only electric auxiliaries are the lighting generators and a few small ventilating sets and ammunition hoists. In order to ascertain the steam consumption of her main engines and auxiliaries, Mr. White, who was serving on board the Minneapolis at the time as one of her engineers, made a series of careful observations during a run of the vessel of seven days from Gibraltar to League Island, Philadelphia. Indicator cards were taken on all auxiliaries fitted for the purpose (thirty-one in number), and the losses from leakage, condensation and radiation were carefully estimated, and the water evaporated carefully measured. The results obtained are certainly startling.

The average weight of steam used by the main engines per hour was 33,620 pounds, and by the auxiliaries 10,146 pounds. That is, the auxiliaries consumed nearly 25 per cent. of the total coal used. The main engines consumed an average of 20.83 pounds of steam per indicated horse-power per hour, and the auxiliaries an average of 119 pounds per indicated horse-power per hour (the lowest being 55.06 pounds and the highest 318.68 pounds per indicated horse-power per hour). These results are not exceptional; in fact, they are probably better than the average obtained on most warships or merchant vessels. The new British cruiser Powerful (14,000 tons displacement) is reported to have used 8300 tons of coal from England to Hong Kong, of which 3400 tons (or 40 per cent.) were required for the auxiliaries.

Under the most favorable conditions the auxiliaries of a large ship probably consume at least 20 per cent. of the total coal and water used. This is more than twice as great as the consumption in a modern central station, and there is no good reason why as good results should not be obtained afloat as ashore.

Let us assume a required central-station capacity for a first-class battleship of 1000 horse-power effective at the motors. The present standard e. m. f. for naval installations is 80 volts, and for the merchant marine about 100 volts. This low voltage was originally adopted on warships on account of the searchlights, which require 50 volts only, and it was desired to introduce as little dead resistance as possible. At this time no motors were, of course, in use, and the electric plant was used for lighting exclusively. Such a voltage is, however, entirely unsuited for a 1000 horse-power plant. The weight of the distribution system would not only be excessive, but the size and weight of the generators would be prohibitive. The three-wire system, or a standard 220 to 225 volt two-wire system, should be adopted, using the necessary resistance in the searchlight circuits when they are in service; since they require a relatively small percentage of the total plant capacity, and are not regularly in use, this can be done without undue sacrifice.

The generating plant should consist of several units of the same size, so that parts are interchangeable, each unit consisting of a compound vertical engine driving a pair of generators or a single generator, depending upon whether a three-wire or a two-wire system is used. Assuming an efficiency of 82 per cent. for engine and generator, and an average line and motor efficiency of 80 per cent., the total efficiency of the system (between the indicated horse-power of the generating engines and the effective horse-power of motors) is 65.6 per cent. In other words, to develop 1000 horse-power at the motors will require 1500 indicated horse-power at the engines, or about 900 kilowatts generator capacity. Six sets of 150 kilowatts each, with one reserve, would be required. A good compound engine working at approximately full load (and with six units those in actual service can always be operated at or near full load), will require 26 pounds of steam per indicated horse-power per hour. Assuming a total efficiency of the system of 65.6 per cent. as above, it will require about 30 pounds of steam per effective horse-power per hour at the motors. If we allow 25 per cent. margin for losses due to steam leakage, condensation, mechanical friction of gears, etc., we still have an economy of 37.5 pounds per horse-power per hour as against 119 pounds as shown by the Minneapolis test. In this case the auxiliaries tested aggregated 471 horse-power developed, using 56,049 pounds of water per hour. At 8 pounds of water evaporated per pound of coal the coal consumption was 7000 pounds per hour, or 84 tons per day, assuming that this power was required for twenty-four hours. If the water consumption had been at the rate of 37.5 pounds per indicated horse-power per hour, instead of 119 pounds, the coal used per day for these auxiliaries would have been 26.5 tons, a saving of 57.5 tons, or nearly 70 per cent.

It is fair to assume that by the introduction of compound engines and improved mechanical appliances on some of the auxiliaries the average steam consumption can, perhaps, be reduced to 75 pounds per indicated horse-power per hour; but this is still 100 per cent. in excess of that required for the electric drive. Assuming an average daily use of 800 horse-power effective at the auxiliaries on a first-class battleship at sea, this difference in efficiency means a saving in water used of 360 tons per day, and in coal a saving of 45 tons per day. All steam cylinders connect with the condensers, so that the water used by the auxiliaries is not lost, but is used over and over again, it being necessary to supply only that lost by leakage in the pipes and condensers. The extra pumping duty is large, however. The coal saved, on the other hand, means that with a given coal endurance (or "steaming radius") a vessel can carry from 10 to 20 per cent. less coal; or, expressed in another way, with the same coal capacity she will have from 10 to 20 per cent. greater steaming radius. The average price paid in the navy for coal (including stations in all parts of the world) is probably at least $7 per ton. There is, therefore, in the case assumed a direct saving in running expense of $315 per day for coal alone. It may be argued that a vessel in port does not use her auxiliaries to the same extent that she does at sea, and that, therefore, the comparisons made are misleading. This may be true as to actual savings in pounds of coal and water, or in dollars and cents, but the percentage difference holds true in any case. Furthermore, a ship is built to keep the sea, and her efficiency and usefulness are measured by her performance at sea, and not when incidentally or accidentally in port. Her weights are distributed and apportioned, and her power, speed and "steaming radius" are designed for sea conditions, and it is these conditions alone which should be considered.

The weight and space required for plant are important matters, for a modern steamship, and particularly a war vessel, has every available inch of space and pound of weight carefully allotted; and it is sometimes difficult for the designers to adjust the conflicting elements (which may be equally important) so as to provide for all and still keep within the prescribed limits. The present weight of steam auxiliaries of a first-class battleship, assuming a total capacity at full load of 2000 horse-power is, as before, about 200,000 pounds, or 100 tons. If the electric drive is used, we must add the weight of generating plant. The Navy specifications limit this weight at present to one-third pound per watt rated capacity. With 1050 kilowatt capacity (six units of 150 kilowatts for service and one for spare) the weight would be 350,000 pounds, or 175 tons. The electric auxiliaries would weigh about the same as steam, or 100 tons, a total of 275 tons as against 100 tons for steam drive. There would be some saving in the wiring, as against steam and exhaust pipes, so that it may be assumed that the electric plant, with the generating sets described, will weigh between two and one-half and three times the steam drive. As an offset, however, we have the saving of 10 to 20 per cent. in coal required for a given steaming radius, which in a ship of this class would amount to between 200 and 400 tons. Furthermore, if in the future a satisfactory steam turbine comparable in economy with the compound engine is developed for marine works, as now seems probable, the weight of the generating plant will be reduced 40 or 50 per cent., and then the electric drive will compare favorably in this respect with steam, and there will still be the saving in weight of coal required for a given endurance.

The space necessary for plant must be considered as one of the vital parts of the ship, and as such it must be located below the protective deck. At first thought it may be said that it will be difficult to find the necessary space, but it must be remembered that the space required for 200 to 400 tons of coal is available, in addition to the space at present allotted for dynamo room, and these combined will certainly be more than sufficient.

The application of the electric drive to the various ship auxiliaries must be carefully studied in each case. The problems involved, however, are not more difficult than many special applications on shore, nor is there anything about them which a competent electrical engineer, with a proper knowledge of sea conditions, is unable to solve. The first cost will undoubtedly be greater than with the steam drive, but the savings in "operating expenses," if capitalized, will much more than offset this difference in first cost.

The problem is purely an engineering one, and should be approached in a businesslike way. Will the electric drive be equally safe, simple and reliable, and will it be more efficient than the present system of steam drive? This is the question in a nutshell, and I believe that the figures and data which I have presented enable us to answer it most emphatically in the affirmative. Other nations, particularly, England, Germany and France, have already introduced the electric drive extensively on their ships both in the navy and merchant marine; and it is earnestly to be hoped that our own Navy, with its magnificent ships, officers and men, of whose record we are justly proud, will not lag behind in this important respect.—*The Steamship.*

THE RECONSTRUCTED CRUISER CHICAGO.

The Chicago under her new lease of life carries very little of the original material that was put into her at the time of her first construction. Indeed, it may be said that the mere shell of the vessel is all that remains of the work done in Roach's shipbuilding yard. In the first place her engines and boilers are entirely new, and are of an improved and thoroughly modern type. Her protective deck, which formerly extended merely above the vitals of the ship (the engine- and boiler-rooms), has now been carried forward and aft to the stem and stern, so as to make a continuous armored protection throughout the ship. And not only the main engines, but all the various auxiliaries with their steam piping and general fittings, are entirely new. In the armament only the heavy 8-inch guns have been retained. The whole of the battery of slow-fire guns on the gun deck has been replaced by a battery of fourteen 5-inch rapid-fire guns of the latest navy type, and the secondary battery of 6-pounders and 1-pounders has been disposed to suit the improved arrangements of the superstructure and the fighting tops.

The great change in the outward appearance of the vessel is due to the alteration in her rig. When she returned from her last cruise she carried her familiar bark rig, with heavy yards on the fore- and mainmasts and a complete bowsprit and jibboom. The yards and jibboom have disappeared, and with them the mainmast, so that the ship now carries two masts (fore- and mainmast) of the usual military type, with a fighting top on the foremast in which are carried two 1-pounder guns, and just below the fighting top a searchlight platform, which is sponsoned out in front of the mast. There is a small signal yard on each mast and a gaff on the mainmast. These changes in her rig, together with the lengthening of the smokestacks, which now extend some eighty feet above the grate bars, have completely changed the appearance of the Chicago, and have given her a much more ship-shape and business-like appearance judged by the modern standards of warship design.

The most important changes in the ship are, of course, those which have been made in the motive power, as may be judged from the fact that the horse-power has been raised from 5000 to 9000, and the speed from about fifteen up to eighteen or possibly to eighteen and a half knots an hour. The machinery of the original ship was of a curious and cumbersome type. It consisted of two heavy compound engines, the cylinders of which were connected to overhead, athwartship, walking beams, which served to drive the crankshafts on the opposite side of the vessel. Thus the starboard cylinders drove the port screw shaft, and vice versa. The boilers were even more out of date, if that were possible, than the engines. They were of the externally-fired return-tube cylindrical type, the furnaces being bricked up around the outer shell. The boilers have been replaced by six Babcock & Wilcox water-tube boilers and four Scotch boilers. With a view to testing the merits of nickel steel for boiler construction, one of the Scotch boilers was built of this material, and if the results in respect of corrosion and general durability are satisfactory, it is probable that nickel steel will be largely adopted for boiler construction. The greater tensile strength of the alloy, as compared with common commercial steel, will enable a considerable reduction to be made in the total weight of boilers for a given horse-power. The Babcock & Wilcox boilers average about 64,200 pounds in weight, with all attachments, but no water. The weight of water is 11,930 pounds; the total heating surface for the six boilers is 14,700 square feet, and the total grate area is 360 square feet, while the pressure for both types of boilers is 180 pounds. The average weight of the Scotch boilers, empty, is 81,400 pounds; the weight of water is 40,430 pounds, the total heating surface is 8562.6 square feet, and the total grate area is 273.52 square feet. It is interesting to note that the weight of water used in the Scotch boilers is over three times as great as that used in the boilers of the water-tube type. The total heating surface of all boilers is 23,352.3 square feet, and the total grate surface is 633.52 square feet.

The ship is driven by twin-screw horizontal triple-expansion engines, the engines being slightly inclined. The high pressure cylinder is 33½ inches in diameter, the intermediate 50½ inches, and the low pressure 76 inches in diameter, the common stroke being 40 inches. All the valves are of the piston type, there being one single piston valve for the high pressure and two each for the intermediate and low pressure cylinders. The total indicated horse-power is 9000. The engines are in two separate watertight compartments, the cylinders being on one side of the center line of the ship, and the screw shafts on the opposite side. Thus the starboard engine, or the engine driving the starboard propeller, has its cylinders lying on the port side of the ship, while the port engine has its cylinders lying on the starboard side.

The ship is provided with a well-found machine shop, in which motive power is furnished by a Greenfield vertical engine. The tools consist of two lathes, two drill presses, one shaper, one emery grindstone, and various machine shop etcetera, besides a well-found bench for vise work.

The system of ventilation has been well worked out. The engine room is ventilated by both exhaust and forced blowing and the ship ventilation is arranged on the same system. The ship is provided with an Allen dense air ice-machine, connected to a freezing box and a cold storage room. The coil also passes through the scuttle-butts to provide cool drinking water for the crew.

Of almost equal importance to the radical changes which have been made in the motive power is the extensive re-armament of the ship which has taken place. The old 8-inch guns which are carried in sponsons on the main deck are retained. They are thoroughly serviceable weapons of the same type as those which did good duty at the battle of Manila Bay on the Baltimore. The gun deck broadside battery of five slow-fire 6-inch guns and four slow-fire 5-inch has given place to a battery of fourteen 5-inch rapid-fire guns. To keep pace with the increased demand for ammunition by the rapid-fire weapons, new electric ammunition hoists have been built into the ship. They are of the endless chain pattern and are capable of putting the ammunition on deck considerably in excess of the ability of the guns.

An interesting installation on this ship is the system of hydraulically operated watertight bulkhead doors invented by Mr. F. T. Bowles of the construction department of the United States Navy. This device, known as the "long arm" system, secures doors which will open and close again tightly under a head of water, and they will close tightly through a doorway full of coal. All the doors can be actuated by a single operator, who from his station on deck can move any single member of the system. The advantage of this concentration of control in case of flooding through attack by the ram or torpedo is obvious.—*Scientific American.*

OUR LATEST BATTLESHIP, THE KEARSARGE.

The Kearsarge and her sister, the Kentucky, will, in some respects, be the most interesting vessels of the new navy; for apart from the fact that they will represent the latest efforts of the Bureau of Construction and Repair and our leading shipbuilders, the vessels possess peculiar interest on account of some decidedly novel features in their design and construction. We refer to the manner in which the main and intermediate batteries are carried, the method of mounting them being known as the double-decked turret system. The system can best be understood by comparing it with the plan adopted in the case of the Iowa, the latest of the large battleships completed for our navy. In the Iowa the main battery of 12-inch guns is carried on the center line of the ship, two of the guns in a turret forward, and two in another turret aft. The intermediate battery of 8-inch guns is carried in four turrets at the four angles of the central armored citadel, amidships. As there are two of these guns in each turret, the intermediate battery is seen to be of a very formidable character.

This arrangement of the main battery in fore and aft turrets, with the turrets of the intermediate battery flanking it, the two 8-inch forward turrets being aft of the forward 13-inch turret, and the two after 8-inch turrets being forward of the after 13-inch turret, also characterizes the three ships of the Oregon class. It provides an unusually powerful "end-on" fire, the concentration ahead or astern being, in the case of the Iowa, two 12-inch and four 8-inch, and in the case of the Oregon, two 13-inch and four 8-inch guns. In the gun trials of the Oregon type, however, it was found that in firing ahead, the blast of the 8-inch guns affected the officers in the sighting-hoods of the 13-inch turrets, if the former were fired closer than within 10° of the longitudinal axis of the ship. This difficulty has been overcome in the case of the Kearsarge and Kentucky in a novel and somewhat daring manner. Four of the 8-inch guns were thrown out altogether and the remaining four were mounted in two turrets, which were superimposed upon the roofs of the 13-inch turrets. By this distribution, not only were the defects of interference overcome, but a more efficient all-round fire was obtained. Though only half the number of 8-inch guns and turrets is employed, the all-round fire from this caliber is better than is possible in the earlier battleships; for on the broadside it is the same, and dead-ahead fire is now possible without interference with the 13-inch gun positions. The 8-inch turrets have been changed from the original designs so as to enable them to be trained independently of the 13-inch turrets—a most important modification.

As regards the rest of the armament, the principal change is substitution of a secondary battery of fourteen 5-inch rapid-fire guns in place of the four 6-inch guns of the Oregon or the six 4-inch guns of the Iowa. So large a battery calls for a large supply of ammunition and a wide area of armor protection, but the throwing out of four 8-inch guns and two turrets placed a large amount of weight at the naval architect's disposal, which he was able to use advantageously in a powerful secondary battery. The great rapidity of fire in the 5-inch battery greatly outweighs the heavier weight of the 8-inch guns which it in part displaces. In sixty minutes' fighting one broadside of seven 5-inch guns could fire fifty-six shells weighing in the aggregate nearly 3000 pounds at a velocity of 2300 feet per second, the total energy of which would be equal to 102,704 foot-tons, sufficient to lift the ship itself 9 feet bodily into the air. The accompanying table shows the broadside discharge:

BROADSIDE DISCHARGE OF THE KEARSARGE.

Number of Guns.	Diameter in Inches.	Weight in Pounds.	Velocity in Foot-Seconds.	Energy in Foot-tons.	Total energy.	Penetration in Inches at Muzzle.	Point of Attack in Enemy.
4	13	1,100	2,100	33,627	134,508	34.6	Belt and main turrets.
4	8	250	2,150	8,011	32,044	21.6	Conning tower and casement armor.
7	5	50	2,300	1,834	12,838	13.0	Thin armor, superstructure, and unarmored ends.

The principal dimensions of the new ship are as follows: Length, 368 feet; beam, 72 feet 2½ inches; mean draught, 23 feet 6 inches; displacement, 11,525 tons. The protection at the water-line will consist of a belt of Harveyized steel, which tapers amidships from 16½ inches at its upper edge to 9½ inches at its bottom edge. It is 7½ feet deep, 3 feet being above and 4½ feet below the water-line. This belt maintains its full thickness, as given, throughout the wake of the engine and boiler space and tapers gradually to 4 inches at the bow. Astern, it reaches to a point aft of the after barbette. Above this belt is a flat deck 2¾ inches in thickness, which extends over the engine and boiler spaces. It is continued forward to the bow and aft to the stern in a curved or turtle-back form. Above the armored deck the sides are protected by 5½ inches of Harveyized steel to the level of the main deck, and this armor is also continued to the level of the superstructure throughout the whole length of the central citadel. There are heavy armored bulkheads extending athwartships from side to side, which inclose the bases of the barbettes. The secondary battery within the citadel is also protected by 5½-inch transverse bulkheads. The 6-pounder battery of twenty guns is disposed eight on the berth deck and twelve on the superstructure deck, while the six 1-pounder guns are placed in the military tops. The vessels each carry four torpedo-tubes.—*Scientific American.*

SHIPS BUILDING FOR THE BRITISH NAVY.

Owing in part to the strike in the engineering trade, which has retarded the completion of very many vessels, in part to the extraordinary efforts of the past few years, we have to-day what is in itself a veritable navy in hand. Taking only the largest class of battleships and cruisers, thirty-five of 9800 tons and over are in a more or less advanced stage of construction, or almost exactly as many ships of the class as the whole French Navy, completed and completing, possesses. The full details of British ships building are as follows:

Battleships of the First Class.		Armored Cruisers.		Protected Cruisers.	
12,950 tons	Canopus Goliath Ocean Albion Glory Vengeance	14,100 tons 23 knots	King Alfred Africa Drake Leviathan	11,000 tons 20¾ knots	Amphitrite Ariadne Spartiate
15,000 tons	London Venerable Bulwark Implacable Irresistible Formidable	12,000 tons 21 knots	Cressy Aboukir Hogue Sutlej Euryalus Bacchante	5,600 tons 21 knots	Hermes Highflyer Hyacinth
				Particulars unknown	A B C
14,000 tons	Cornwallis Duncan Exmouth Russell A B	9,800 tons 23 knots	Essex Bedford Kent Monmouth	2,135 tons 20 knots	Pandora Pioneer Prometheus Pyramus Perseus
	18		14		14

Besides these ships, which displace between them over 488,000 tons, or as much as the total displacement of the whole United States Navy, eight sloops, four light-draught gunboats building for the Yangtse, and about thirty destroyers, besides two first-class torpedo-boats, must be included. This gives a total of some ninety vessels in the category of ships not yet completed for the navy.

Excepting one or two of the destroyers which have been singularly and most unaccountably delayed, all these ships were laid down in 1896 or the following years. The general impression that it takes only two years on an average to build a battleship in England is not confirmed by an examination of the list of ships building. The first five of the Canopus class appeared in the 1896 estimate, and were laid down in the closing months of 1896 or the opening months of 1897. Not one of them is as yet complete, though the Canopus should be ready for sea this autumn. They have all been thirty or thirty-one months in hand.

Again, the intended construction of the Formidable, Implacable and Irresistible was announced in March, 1897, but they were not placed upon the stocks till just a year later, in March or April, 1898. If, as should always be the case, we reckoned the time taken to construct a ship from her first appearance in the estimates to the completion of her trials, three to three and a half years would be the average for the larger vessels. Yet even this figure, though at first sight not very wonderful, compares favorably with the results obtained in other navies. Russia, however, has lately taken to buying ships in the United States and a large cruiser ordered last year for her will be delivered this year, while a battleship, also ordered last year, will be ready next spring.

One fact which appears from the table given above is the large number of ships of each type that we build. In battleships, for instance, we have three groups, each of six ships all identical. The groups are further very similar in offensive and defensive power and steaming radius to each other, so that they are well adapted to act in unison. All have water-tube boilers, which, in spite of the furious and prejudiced attacks now being made upon them, have been adopted by every navy in the world. The fastest group of the three is the Cornwallis type, the ships of which will steam 19 knots with natural draught; the Canopus class is expected to do 18¼ to 18½ knots, and the Formidable class 18. All are almost identical in armament; each carries four wire 12-inch guns and twelve 6-inch quick-firers, besides a small number of 12-pounders and 3-pounders. In this latter direction they are far more weakly gunned than the new Russian ships, which carry forty-six small guns against our Cornwallis's eighteen.

In outward appearance it would take a trained eye to distinguish between the various types. They appear very much the same with two funnels, two military masts, and the high freeboard which is now inseparable from our ships. Great seaworthiness and extreme endurance are aimed at by Sir William White in his designs, and generally obtained. As for the steaming power of his ships, we may note that the Renown, with one screw damaged, crossed the Atlantic at a uniform pace of a little over 15 knots, or about 4 knots more than the Oregon made on her record voyage. The Cornwallis class, with full load, should be good at sea for 17½ or 18 knots.

Next in importance to the heavy battleships come the armored cruisers, of which so many are building for the navy. These are virtually battleships, in which protection and armament are somewhat reduced to get a higher speed. Far the finest are the four improved Powerfuls, known as the Drake class. The Powerful had no plating on her side; these ships have 6 inches of Krupp steel. The Powerful only carried two 9.2-inch and twelve 6-inch guns; these have two 9.2 and sixteen 6-inch guns. Lastly, the Powerful steamed only 21.8 knots; these are to steam 23. They will be huge four-funneled vessels, in general outward appearance differing little from the Powerful. Like her, they will be at home in any sea, and able to face the worst weather. In fighting qualities, they are fully equal to most British and foreign battleships of not the most recent construction.

They are followed by a class of six armored cruisers, smaller, slower, not so heavily armed, but all the same of 12,000 tons, known as the Cressys. They are to steam 21 knots, and carry the same battery as the Drakes, except that they have four less 6-inch guns. They also are, and are designed to be, something very near a battleship. Admiral Sampson of the United States Navy is inclined to think that this class of powerful armored cruiser will gradually displace the slower and heavier battleship. If so, it is thoroughly satisfactory to reflect that we have so many of the kind in hand.

The smallest of the armored cruisers, the Essex class, are not the least interesting; they will, probably, have three funnels, differing in this respect from the preceding, which have four. They are to steam 23 knots, and will carry fourteen 6-inch guns, all behind 4-inch armor, while armor of the same thickness will protect their water-line. They are splendid designs, combining all the ideal features of the cruiser, and should be much superior to the American armored cruisers Brooklyn and New York, which did such good service in the late war.

The first six in the list of protected cruisers have been often described.

The Amphitrite and her two sisters are reduced copies of the Powerful, and are defective from their want of side armor. The Hermes is a good specimen of the moderate sized heavily armed cruiser. As for the new ships, A, B, C, they are to be of different type, and should steam 25 or 26 knots to meet the Russian cruisers of the Novik class, two or three of which are to be ready in 1900, and which are to steam 25 knots. In 1890, 19 or 20 knots was considered a fair speed for a small cruiser, but lately sharp competition between the powers has sent up speeds very much, while the water-tube boiler gives the designer plenty of power on a low weight. The small cruisers of the P class are not very interesting; several are already in service, two with the Channel Squadron. They are seaworthy, but not very fast, and are rather lightly armed. The sloops are rigged to use sail power as well as steam, and are useful little ships for colonial service. They draw very little water and are meant for police purposes rather than for fighting. Ships of this class in the United States Navy, however, did good work on the Cuban coast in the late war.

Of the light-draught gunboats, one, the Dwarf, had her trials some weeks ago. She made 13 knots. What promises to be the fastest vessel in the world is building for the navy in the turbine-engined Viper. She is expected to go 35 or 36 knots, and her small 312-ton hull will hold machinery developing 10,000 horse-power. Yet she is only the first experiment in a new development which may give us yet greater wonders.

The total displacement of ships now under construction for the British Navy amounts to no less than 488,000 tons. There are six battleships of 12,950 tons; six battleships of 15,000 tons; six battleships of 14,000 tons; four armored cruisers of 14,100 tons, with a speed of 23 knots; six armored cruisers of 12,000 tons, with a speed of 21 knots; and four armored cruisers of 9800 tons, with a speed of 23 knots, besides fourteen protected cruisers.—*Black and White.*

PRESENT AND PROPOSED CRUISERS OF THE UNITED STATES NAVY COMPARED.

The recent war has imposed upon the United States responsibilities that are entirely novel and of far-reaching consequence. The battle of Manila sounded the death-knell of our policy of isolation, and the treaty of Paris so greatly extended the borders of our possessions that they may now be said to be conterminous with those of every nation that has a fighting ship afloat upon the high seas. Hence our navy has taken on a new meaning in the minds of the American people—it is no longer a mere adjunct of our coastline fortifications; it is our foremost line both for offense and defense. The countless islands of the Philippines scattered over a hundred leagues of sea call for ships that can steam both far and fast, ships which, when they have outstripped the enemy, can present a fighting line that is better able to give and take the hard knocks of a sea fight, and reasonably sure to fulfill to the letter the significant orders, "Sink or destroy."

In our issue of August 19, we gave some details regarding the plans of the proposed six new cruisers which were authorized by the last Congress, and showed that if these ships are built as designed they will be greatly inferior to ships of a similar size and type that are built or building for other navies of the world. Among the vessels selected for comparison was a United States ship, the New Orleans. We are now enabled to present for comparison the new cruiser and the New Orleans, and with a view to bringing out clearly the points of advantage possessed by one over the other we have compared the ships point by point in tabular form. We find that the full load displacement of the New Orleans is slightly over 3500 tons, or practically the same as that of the new cruisers. This vessel is, therefore, an admirable foil to set off the good or bad points of the new design, for not only has she been tested in actual warfare, but, like the Denver class, she is sheathed and coppered and therefore suitable for a long stay in tropical waters without docking.

We find, then, that on every point but one the New Orleans shows a superiority, and on some points an overwhelming superiority, over the proposed cruisers; for she has 4½ knots more trial speed, she carries 100 tons more coal, has a 1¼-inch protective deck as against none, and has 3 inches of armor along the side slopes of the deck as against 2 inches for a third of the length; she carries 407 men as against 290; she has at present two torpedo-tubes as against none, and her battery is heavier and more numerous. And yet the New Orleans, though an ideal fighting machine, is not by any means a phenomenal boat; she merely represents modern ideas among the naval constructors of the world as to what elements should be combined in an up-to-date 3500-ton sheathed and coppered cruiser.

It will naturally be asked, What has been done with the 3500 tons of displacement in the new designs? It is reasonable to suppose that with a speed less by from 3½ to 4½ knots (for the ships according to the contract may be accepted at a reduced price if the speed is less than 16½ but does not fall below 15½ knots), with 100 tons less coal, no protective deck, no torpedo-tubes, and also with a saving in weight due to carrying 117 fewer men and their supplies—it is reasonable to suppose, we say, that some compensating advantages must appear in the new boats that are not seen in the New Orleans. There is an undoubted advantage in the fact that the new ships are to have a flush upper deck, and will, therefore, be drier boats in heavy weather, and will provide more liberal breathing space for officers and crew. The New Orleans has a forecastle deck, an open waist amidships, and a poop, whereas in the new ship the space between forecastle and poop is decked in, thereby affording an unbroken upper deck from stem to stern. This means the addition of considerable weight at a height of 16 or 18 feet above the water-line, and other things being equal, we should expect that this addition was made at the sacrifice of some other features of the ship. But other things are not equal; for even if we allow that the 1¼-inch protective deck of the New Orleans offsets the weight of a flush upper deck, that vessel still possesses a vast superiority in speed, better protection on the slopes, more coal, and over 30 per cent. more men to fight the ship; to say nothing of the superiority of her armament.

While it goes without saying that a ship with a flush upper deck is drier in a seaway than one with forecastle, open waist and poop, it has yet to be proved that it is wise to sacrifice speed, coal and armor merely to prevent a ship from throwing a little water aboard in squally weather. Unless we have altogether misread the lessons of American naval history, unless we have quite failed to appreciate the fighting spirit of Paul Jones, Decatur and Farragut, we think that the typical American seaman would be quite willing to receive an occasional swish of salt water in his eyes or a roll of green seas across his deck for the sake of an extra gun or two in his battery, or 3 or 4 knots extra speed on tap in the engine-room at the critical moment. During the operations of the late war the New Orleans was able to respond at any moment to a call from the Admiral for a 19-knot sea speed, and her varied experience in the twelve months of her service has never seen a time when she could not "cast loose" her guns for action. Seaworthiness is of course a prime factor in a warship, but in this, as in all other matters, it is possible to go to extremes. England has done so, with the result that many of her ships are, in proportion to their size, the most under-gunned vessels in the world. In our six new cruisers, it is the speed and protection that have been sacrificed.

It is claimed that another feature in which the new vessels are superior is the accommodations for officers and crew. These are stated to be very superior, a point that may well be conceded, for upon the same displacement and with hundreds of tons saved upon engine and boiler weights, protective deck and torpedo outfit, she carries only 290 men as against 407 carried by the New Orleans. Here again it looks as though a principle good in itself, and when applied in moderation, had been pushed altogether too far. Inquiry of both officers and men who have served on the New Orleans failed to elicit any serious complaints of inconvenience due to overcrowding. Give to the typical American sailor a reasonable amount of living space, and then offer him his choice between more guns, more speed and better protection, or a few cubic feet additional space in his living quarters, and he will take the ship with the better fighting qualities in every case.

It is evident from the shallow draught and short length of the proposed ships that their slow speed must be due in part to their fuller lines. Although the New Orleans is 54 feet longer, of 3 feet more draught and the same beam, her displacement is about the same. Hence it is certain that her lines must be very much finer and undoubtedly the 4½ knots extra speed is partly due to this. Again, her large horse-power (7500 as against 4500 for the new boats) is obtained without a proportionate increase in weights, by using a high speed of revolution in the engines; a principle that has been adopted with success in other ships by the same designer. Other economies in weight are due to the fact that from stem to stern there is nothing in the ship of the purely ornamental or fanciful; the broad principle of utility has been followed to its ultimate limit, and in this respect the New Orleans is more like an American production than the product of a European yard.

The effort of the department to secure ships of exceptional seaworthiness and liberal berthing accommodations is highly commendable; but we think it is evident from what we have said that the sacrifices in speed and protection are out of all proportion to the benefits secured. It would have been better to have taken the New Orleans as a basis and given her a flush deck and improved freeboard at the cost of an additional two or three hundred tons of displacement rather than to have gained roominess and comfort by building half-protected cruisers, which, by the very terms of the contract, may be thrown upon the country's hands with a speed of only 15½ knots, and this, moreover, in an age of 20-knot battleships!

COMPARISON OF PROPOSED 3400-TON CRUISERS WITH SIMILAR SHIPS IN OUR OWN AND FOREIGN NAVIES.

Name of ship	Proposed Cruisers.	Montgomery.	New Orleans.	25 de Mayo.	Puglia.	Suma.	Novik.
Name of navy	United States.	United States.	United States.	Argentina.	Italy.	Japan.	Russia.
Date	1899.	1889.	1896.	1890.	1898.	1899.	1899.
Full load displacement, tons	3400	2229	3437	3300	2650	3100	3000
L. W. L. length	292 ft.	298 ft.	346 ft.	325 ft.	269 ft.	306 ft. 8 in.	347 ft.
Extreme beam	43 ft.	37 ft.	43 ft. 9 in.	43 ft.	41 ft.	40 ft.	40 ft.
Total bunker capacity, tons	700	340	800	600	750	627	500
Trial speed, knots	16½	19	20	22.4	20	20	25
Protective deck	none at ends	none	1¼ in. to 3 in.	2 in. to 4½ in.	1 in.	1 in.	1¼ in. to 2 in.
Battery	ten 5-in. r. f. eight 6-pdrs. two 1-pdr. 4 machine guns one field gun	ten 5-in. r. f. six 6-pdrs. two 1-pdr. two Colts 1 3-in. field gun	six 6-in. r. f. four 4.7-in. r. f. ten 6-pdrs. four 1-pdr. 4 machine guns. two field guns	2 8.2-in. B. L. R. eight 4.7-in. r. f. twelve 3-pdrs. twelve 1-pdr.	four 5.9-in. r. f. six 4.7-in. r. f. one 12-pdr. eight 6-pdrs. 2 machine guns	two 5.9-in. r. f. six 4.7-in. r. f. twelve 3-pdrs.	six 6-in. r. f. numerous secondary battery
Torpedo-tubes	None.	2	3	6	2	2	6

The next comparison is with the Puglia, an Italian cruiser which, if sheathed, would displace about 2800 tons and have a speed of 19¾ knots. On 700 tons less displacement, she carries a somewhat more powerful battery and 50 tons more coal, has a complete 1-inch protective deck and 3¼ knots advantage in speed, besides carrying two torpedo-tubes. This is, perhaps, the most striking comparison of all, for it shows that as compared with a boat fully 25 per cent. larger than herself, the Italian cruiser, if sheathed, would possess a positive superiority on all points of comparison and an overwhelming superiority in speed and protection.

Japan, on 200 tons less displacement (supposing the Suma were sheathed), possesses a vessel with 3¼ knots more speed, a complete protective deck, a slightly less powerful battery, and two torpedo-tubes as against none.

Finally, as showing that our 16½-knot cruisers are directly at variance with the latest trend of ideas in naval construction, we quote the cruiser Novik, now under construction in a German yard for the Russian Navy. She is said to be the first of a fleet of ten similar ships, whose designer represents the theories of Admiral Makaroff, one of the most brilliant and thoughtful naval strategists of the day. This vessel is to combine the qualities of the torpedo-boat destroyer and the cruiser; and with her armament of six 6-inch rapid-fire guns, and numerous secondary battery, combined with six torpedo-tubes of the under-water type, her offensive qualities may be said to be at least equal to those of the 16½-knot cruisers. If sheathed, the Novik would displace 3200 tons. On 300 tons less displacement, she carries 200 tons less coal than our proposed boats, but, as against this, she has a complete protective deck, 1¼ inches on the flats and 2 inches on the slopes. It is when we come to the comparison of speed, however, that the enormous disparity between the two boats is seen, for the Novik will be 50 per cent. faster, having a speed of 25 knots as against the 16½ knots of our cruisers.

If the facts of the above comparison prove anything, they establish that if we build the six proposed cruisers we shall possess a class of vessels regarding which we shall be bound to admit that, for their size and date, they are the slowest and most defenseless vessels in the world, and quite unable to stand comparison with similar foreign ships in military, tactical or strategetical efficiency.—*Scientific American.*

THE IMPERIAL JAPANESE BATTLESHIP HATSUSE.

Elswick has turned out many important warships in its time, but the first-class battleship Hatsuse, launched for the Imperial Japanese Navy on Tuesday, June 27th, last, by Madame Arakawa, exceeds all others in importance, since she is the last word in naval architecture to date. Her principal details are as follows:

Displacement	15,000 tons.
Length—between perpendiculars	400 ft.
Beam	76 ft. 6 in.
Depth	43 ft. 11 in.
Draught—mean	27 ft.
Indicated horse-power	14,500 tons.
Contract speed	18 knots.
Coal supply—normal	700 tons.
Bunker capacity	1690 tons.

Armament—Four 12-in. new type rapid-fire Elswick.
Fourteen 6-in. 45-caliber Q. F.
Twenty 3-in. Q. F.—12-pounders.
Eight 3-pounders.
Four 2½ pounders.
Four submerged torpedo-tubes, one above water in stern.

Armament.	Hatsuse. (Japanese.)	Majestic. (British.)	Canopus. (British.)	Formidable. (British.)	New Maine. (U. S. A.)	Retvisan. (Russian.)	K. Potemkin Tavritchesky. (Russian.)
A—12-in. rapid-fire	4	—	—	4	4	4	4
" ordinary	—	4	4	—	—	—	—
D—6-in. Q. F.	14	12	12	12	14	12	16
F—3-in "	20	16	—	16	nil	20	14
Submerged tubes	4	4	4	4	2	4	4
Armor.							
Belt amidships	*a*	*a*	c	*a*	*a a a*	*a*	*a*
" bow	*d*	nil	*f*	*f*	d^a	*f*	nil
" stern	*d*	nil	nil	*f*	*d*	nil	nil
Citadel, lower deck	c	*a*	c	*a*	*d*	c	*a*
Casemates	c	c	c	c	c	c	c
Barbettes and bases	*a a*	*a a*	*a a*	*a a*	*a a*	*a*	*a a*
Barbette shields or turrets	=*a a*	=*a a*	=*a a*	=*a a*	=*a a*	*a*—turrets	*a a*
Protection to vitals	=*a a a a*	*a a a a*	=*a a a*	=*a a a a*	*a a a a*	*a a a a*	*a a a a*
Speed—contract—maximum	18 kts.	17½ kts.	18¼ kts.	18	16	18	18
Displacements with normal coal supply	15,000	14,900	12,950	15,000	11,500	12,700	12,500

Armor.—The Hatsuse is completely belted on the water-line, the part amidships having a uniform thickness of 9 inches. Krupp process armor; forward and aft this belt diminishes to 4 inches, while the lower deck above it, for 250 feet amidships, constitutes a citadel 6 inches thick. At either end of this citadel rise the circular barbettes, 14 inches thick. On the main deck there are each side four casemates for eight 6-inch Q. F. carried on this deck. These have the thickness, classical now to all navies except the French, of 6 inches in front and 2 inches at the back. Each casemate gun will be furnished with a stout circular shield. There is a report current, we believe, that some alteration in design will be made here, if not for the Hatsuse, at least for her sisters. The objection raised to casemates is that while they afford the maximum of protection by their stout fronts and isolation, their thin backs, though nominally proof against 6-inch shell, may soon cease to be so. In any case they are vulnerable to shot. Any projectiles hitting the main deck amidships, if they miss the casemates, stand to hit the backs of the casemates on the off side, and all might be put out of action for that cause. We do not think such an event is very probable with shell—the high explosive shell; the 6-inch shell of the future is almost certain to be exploded by the unarmored skin or else by obstructions between decks. The odds are also against common shell reaching the backs of off-side casemates intact. Shot, of course, would; but how much in the way of shot for the 6-inch guns does any battleship carry?

The question of fire—one fatal objection to the casemate system—can be dismissed at once in the case of the Hatsuse, since she will not carry anything inflammable on the main deck. Nothing remains to be considered, therefore, in the matter of shell except the problem of shells twisting between the casemates, and fragments finding their way down to the engine-room. Precautions are taken to meet this eventuality, and the only serious objection remaining is the question of assuming shot to be used to attack the rears of the casemates. In naval kriegspiel this has been evolved as one of the two possible methods of attacking the secondary armament of modern ships. It presupposed a supply of shot that the attack does not yet carry. The other attack—showers of shell directed at the ports of the casemate guns in the hopes of getting stray shells inside, or of smashing the guns—a continuous battery is no more safeguard against than a casemate, while against big A. P. shell the casemate, by isolating its result, is the best protection. On the whole, therefore, the casemate is probably best. The Russians—who have usually a large array of experimental data, not necessarily their own, to go upon—have discarded the continuous armored battery on the Sissoi Veliky and Tri Svititelia types for the casemates of the Peresviet. The Americans have abandoned the battery of the Kearsarge for the casemates of the new Maine and Alabama. To resume—on the upper deck there are six more casemates, those at the extremities firing fore and aft, the center pair being amidships. Between these, above them, and on the main deck fore and aft, the 12-pounders are carried, the distribution being thus:

			Total.
Main deck forward	2	each side	4
" aft	2	"	4
Upper deck amidship	2	"	4
Topside—boat deck	4	"	8
			20

These 12-pounders are, perhaps, the most important feature of the ship; at any rate, the most novel as compared with our Majestic, Canopus, Formidable and London classes. They are exceedingly well distributed—an absolute necessity with guns having no protection save shields, and those upon the boat deck have a splendid arc of fire. The arrangement adopted in the British Navy cannot be compared to that in this Japanese vessel.

The 12-inch guns do not call for any special comment, the circular barbette having everywhere ousted the pear-shaped type. Heavy sloping shields of hardened steel will protect the guns, which will, of course, be balanced with the central loading position to avoid any necessity of training guns fore and aft to load. One innovation deserves mention, however. We understand that for these guns Elswick will adopt a system which will allow of their being loaded at any elevation or depression, thus converting these guns into what quick-firer implies to every naval man. The essential point of a 6-inch quick-firer is that it has not to be re-laid between each round.

The protective deck behind the water-line armor belt varies from 2½ inches to 4 inches thick upon the slopes. In conjunction with coal bunkers there is, therefore, a protection to the vitals equivalent to about 30 inches of wrought iron armor, belt, coal and deck. The main deck is to some extent an armored deck also, being 1 inch thick.

It will be noted that the coal supply of the Hatsuse is, in comparison with British standards, relatively a low one. We expect to see the point seized upon as a text for dissertations upon the question of coal supply versus offense and defense, and its relation to design. Those who do so will be under a delusion. The coal supply is not relatively lowered in order to increase the armor or armament; it stands at the figure it does, not by choice of the designer, but by policy of the Japanese Admiralty, who, intending as they do to use their ships in home waters, where coaling stations are numerous, have no occasion to regard coal supply in the light that we are compelled to.

The other salient point of difference between the Hatsuse and British Navy designs is the citadel. In British ships—except the Canopus class—it is 9 inches thick. This thickness keeps out all shell, unless the Russian and American capped A. P. shell prove equal to the testing ground performances.

A 6-inch band will not keep out big A. P. shell, and there is some opening to do damage under the casemates. But big A. P. shell are necessarily few, and the damage they do with their small charges is not much greater than what shot might effect; indeed, circumstances are conceivable, and results could be cited tending to show that the solid shot is likely to do more harm. Not only may bits of armor carried through do as much harm as bits of an A. P. shell, but the intact shot has in many known instances an extraordinary way of wandering about inside a ship up and down and round corners. Nine inches is not much better than 6 inches where big shot are concerned. The 6-inch citadel means a real as opposed to a more or less nominal armoring of the bow and stern water-line, and no one any longer upholds soft ends. Naval men never did.

The 12-inch "quick-firers" have already been referred to. Practically they double the efficiency of the heavy pieces. The Hatsuse will have twenty-five Belleville boilers fitted with economizers. The heating surface will have an area of 37,936 square feet; there will be two screws.

In concluding this brief notice of a battleship that represents the last word in modern construction, we will compare her fighting elements with those of certain contemporary and earlier ships, using, for convenience, the Naval War Game notation. We may mention that in a recent number of *The Engineer* a comparison between the Shikishima—a very similar vessel—and the Russian Peresviet has already been made.

The London is simply the Formidable with *e* instead of *f* forward—3 inches instead of 2 inches. The new American ships are 18-knot Maines, of 500 tons more displacement. This comparison brings out how very similar modern designs are in many points. The variable quantities are chiefly bow belt and citadel, or armament, except in the case of the Canopus, which has weakly protected vitals, and nothing to show for it save ¼ knot extra speed.

The values of armor bearing the same letter are not always the same—the Canopus' *aa* is not equal to the Hatsuse's *aa*. Still, the difference is comparatively slight, and is purposely not accentuated because, so far as guns are concerned, what will get through one *aa* will in all probability get through the other. All the heavier ships have advantages here; they have another advantage, too—their belts are wider. The well-nigh impenetrable American belt is the merest fraction of the whole width, and the whole width is a good deal less than the Hatsuse's 7½ feet against 8¼ feet, while being a less heavy ship the seas may be expected to move her more. Further, the Maine, for some reason best known to her designers, will, we believe, like the Alabama, carry a couple of 6-inch casemates forward. How the Americans think these guns will be fought with the big guns firing over them we do not know. Twelve-pounders so placed cannot be used when the big guns are firing; but 12-pounders are carried to repel torpedo attack when the big guns would not be wanted. Six-inch guns have quite other uses. American designers, in their haste to put guns where other ships do not carry them, overlook the cardinal possibility of other designers having thought out and discarded the same thing. In addition, they should know that shooting from guns forward is never good. In our Edgar and Undaunted classes the 9.2-inch forward—carried higher than the forward 6-inch guns of the Alabama—obtain about a third only of the hits secured by the after 9.2-inch. We emphasize this point, because the disposition of the fourteen guns in the Hatsuse and in the Alabama type is a characteristic difference.—*The Engineer*.

THE BULLFINCH DISASTER.

It will be remembered that the Bullfinch is a torpedo-boat destroyer built by Earle's Shipbuilding and Engineering Company, of Hull, and is one of the 30-knot class, the contracts for which were pretty widely distributed. She is 210 feet long and 20 feet 6 inches broad, her displacement being about 300 tons, and the specified horse-power for full speed 5800 indicated. She has two sets of four-crank three-stage compound engines, the high-pressure cylinders being forward, the intermediate cylinders next, and the two low-pressure cylinders aft. Steam is supplied by four boilers of the Thornycroft type, these being loaded to 250 pounds, but this was brought by a reducing valve to 210 pounds at the engines. The vessel had run a successful trial before leaving Hull, having made 30 knots on the measured mile. On reaching Portsmouth a trial was made, which was unsatisfactory in regard to speed, but this was found to be due to the faulty state of the paint on the vessel's bottom. On a second trial the speed was well maintained, but just before the end of the three hours' run a balance-weight flew off the forward port crankshaft, falling down into the bilge, without, however, doing much damage. The balance-weights were at first of manganese bronze, but after the accident they were replaced by those of forged steel.

The six runs had been made on the Stokes Bay mile, the average speed being 29.74 knots. A run was made down the Solent until off Yarmouth, when a return trip was made until the Nab lightship was passed, after which the vessel returned, again, passing Spithead until off Ryde Middle. The engines are reported to have been working smoothly, causing very little vibration to the vessel, and with "an absence of thumping of any sort." At 1.10 P. M. the accident occurred by which eleven lives were lost.

Mr. Dathan had just gone into the engine-room, whilst a few minutes before Mr. Tyacke had gone below in the after part of the vessel, and therefore did not witness the accident. Mr. Tremayne, one of the staff of the contractors, was in the engine-room, and was most seriously injured. Mr. Dathan stated that he had just stooped to feel the brasses of the port air-pump rocking lever, when the accident happened. The engine-room was almost instantaneously filled with steam, but he dropped on his hands and knees and crawled to the foremost ladder, an exercise of presence of mind that doubtless saved his life. He managed to climb up the ladder to nearly the top, but would have fallen back had he not been assisted to the deck. In spite of his injuries, he gave orders to have the stop valves closed, and then went forward and reported the accident to the officer in charge.

What had happened to the starboard engine was that the high-pressure connecting-rod had parted at the fork, and the cylinder itself had broken for two-thirds of its circumference just below the cover-flange, and it was through this fissure that the steam escaped and scalded the men to death. The breaking of the connecting-rod had led to a bolt being shot through the bottom of the vessel making a considerable hole through which water was coming fast. Lieutenant Dineley got out collision mats and the pumps were set to work. A dredger first took the Bullfinch in tow, but she was afterwards taken into Portsmouth by a tug.

The point of engineering interest about this unhappy accident is, of course, how the connecting-rod came to give way. It was a forged steel rod supplied by Cammell's, and was bored with a 2-inch hole from end to end, the rod itself being 3½ inches in outside diameter. The manner in which it gave way was altogether remarkable, the rod splitting, or, rather, one would say, the metal parting at the top end. This "vertical fracture" proceeded some little distance, and the rod was then pulled apart. On examination afterwards, it was found that in the rod of the intermediate cylinder, of the same set of engines, there was the commencement of a similar vertical crack; whilst both the high-pressure engine and the intermediate-pressure engine of the port side had similar vertical cracks. The two low-pressure rods of both the port and the starboard sets of engines were apparently quite sound. Presumably the low-pressure stage, being divided between two cylinders, would have less power developed in either one engine.

The question turned upon faulty material or faulty design. Here we may say that we use the objectionable word "faulty" in its absolute and literal sense, and not comparatively. That something was faulty is proved by the fact that something gave way, but that is not to say that some one was to blame. Fortunately, in this case, we have the broad shoulders of Mr. Seaton on which to place the burden, and all know that Mr. Seaton is one of the ablest marine engineers of the time, and indeed, stands in the very foremost rank of his profession. He, and those who work with him, have a long series of successes to point to in the construction of machinery for H. M. Navy, and we may conclude that all reasonable precautions, and the highest technical skill were displayed in getting out the designs and superintending the construction of these engines. The cause of the accident is extremely obscure, and one quite without precedent so far as we are aware; and, although it has resulted so disastrously, we cannot see that either the contractors, or the Admiralty officials, can lay anything to the charge of their own consciences.

Mr. Seaton, who gave evidence at the inquest, perhaps not unnaturally, thinks the defect in the connecting-rod was due to faulty material rather than to an error of design; and in this he is—equally naturally—supported by Mr. Tyacke. Messrs. Cammell, whose representatives also gave evidence at the trial, as might certainly have been surmised, consider the material was all right, and—without pretending to the knowledge of marine engineering experts—think the design was capable of improvement.

However that may be, the design in its general features is not an uncommon one, and every precaution seems to have been taken, so far as the evidence goes, to use only the sound part of the ingot. Mr. Oram, who gave evidence in a straightforward and fearless manner, happily now characteristic of the engineering branch at the Admiralty, was inclined to attribute the accident partly to design and partly to material. He acknowledged responsibility and said that the Admiralty would profit by the experience. It is a great thing to find a Government official shouldering responsibility, fearless of the criticism of those wise after the event.

The 2-inch hole through the 3½-inch connecting-rod would give a tube with a thickness of metal of ¾ inch at the top, whilst at the bottom, where whipping strains would be more likely to be apparent, the metal was thickened to give a full inch. The rod, Mr. Tyacke said, would not be required to stand a strain exceeding 7000 pounds to the square inch, whereas the minimum test was 30 tons, and the maximum test 35 tons. The average revolutions on the run were 392 per minute, so that the change in stress from compression to tension occurred with the greatest rapidity.

Naturally the wisdom of boring the rod was called in question during the inquiry, and such a "weakening of the metal" has been denounced. Now, it is hardly necessary to state here that rods are not bored simply to save a few pounds in the total displacement of the boat, but because the connecting-rod is a part of the moving weight. It is not so much the stresses due to steam pressure that have to be considered in these very quick-running engines, as the strains that may be caused by the inertia of the moving parts. The complicated stress diagrams needed to decide what section of metal should be given cannot be taken as an absolute guide, and therefore a wide margin of safety has to be allowed, and this should cover reasonable variations in the strength of material. There appeared to be some difficulty in tracing the ingot from which the rods of the Bullfinch were made, but this may have been, as was suggested, owing to the marks having been filed off. In any case, however, there is not the slightest reason to suppose the Admiralty requirements were not satisfied. These demand that 30 per cent. of the top of the ingot should be cut off in making the bloom from which the rods were forged. Three per cent. is also required to be removed from the bottom end in making the forging. As a matter of fact, we are informed that Messrs. Cammell only used 38 per cent. of the ingot in making this forging. The bender pieces are 6 inches long and 1 inch square, and were bent to 180 degrees without breaking. In the tensile tests the metal had to undergo an elongation of 27 per cent., and to stand a strain of 30 to 37 tons to the square inch. The analysis of the metal from which the connecting-rods of the Bullfinch were made was produced at the inquest, and was said to be normal, with no excess of sulphur.

The form of the fork end of connecting-rods is a matter that will doubtless be carefully considered by contractors, and at the Admiralty just now. At present the ordinary U-form of fork is usually adopted, but it may be questioned after this whether a V-shape, or, perhaps, rather a Y-form (the stem of the Y forming the top end of the connecting-rod) may not be preferable. With the extremely rapid alternation of stress before referred to it is highly desirable to dispose the metal as nearly as possible in line with the stresses, both those due to steam pressure and to inertia. It will be seen that the flat-bottom part of the U-shaped fork does not comply with this requirement so nearly as the V-shape. If we carry the U-form to an extreme, and suppose the jaws of the fork separated by a considerable interval, so as to get a wide flattened bottom to the fork, it will be seen how pressure transmitted through the gudgeon-pin to the jaws will tend to break the cross-piece forming the bottom of the fork owing to the bending stress thus applied. From this point of view the extension right to the top of the hole bored in the connecting-rod is bad, as it takes away metal where it is most required. Mr. Seaton very properly objected to a partially bored connecting-rod on account of the weakness incidental to a change of section. It is possible, however, that the hole might be made near the top in steps of lessening diameter, the steps afterwards being machined to a gradual slope by a taper reamer, or, of course, the metal could be added to the outside, but this would give a clumsy appearance.

The method of fitting the gudgeon also bears strongly on this point. For big engines the arrangement of brasses in the jaws of the connecting-rod fork is considered the most convenient, and for the comparatively few reciprocations of large marine engines the advantages of this method are apparent. For high-speed engines, however, there is the very serious objection of having four bolts and four nuts to tighten up equally and accurately. Mr. Tyacke stated that it was reported to him before the trial that every bolt, nut, and pin had been overhauled and set up, and no doubt with so good an engineering staff as that of the big Hull firm no pains were spared to get everything into perfect going order. Even the most careful attention, however, is not always sufficient to insure accuracy in such details as these, and it is only by long training in this special class of work that men can be depended upon to know exactly what to do; even then they must be specially gifted for the work. For this reason two bolts are better than four; it is evidently easier to get two set up equally than to get four set up equally. Moreover, it is preferable to have the gudgeon shrunk into the connecting-rod fork, and have the brasses on the piston-rod, because this arrangement lends itself more readily to the two-bolt arrangement, but beyond this the pin is an important element of strength in holding the jaws of the fork end together more firmly than they otherwise would be. The slacking back of nuts is a very important detail to provide against, and a small defect in this particular may upset very careful calculations as to stresses. A good deal of ingenuity has been expended on this problem by the builders of these small high-speed craft. This danger again points to the desirability of two bolts rather than four.

We notice that Mr. Seaton no longer thinks steel preferable to iron for resisting violent stresses, the present accident contributing to shake his faith in steel. This is the kind of reactionary statements that one often hears after an accident, but we do not think Mr. Seaton will be likely to put iron connecting-rods into destroyer engines in future. For our own part, the only breaking of a connecting-rod in a torpedo craft we ever witnessed was that of an iron rod, and the accident was very much on the same lines as that to the Bullfinch, the air pump being quite demolished by the flail-like action of the broken rod. Fortunately, however, no lives were lost, as the cylinders stood the test. This was in the early days, and we had a feeling in regard to the material for connecting-rods very similar to that which Mr. Seaton has expressed, only in exactly the reverse direction. It is true that with a homogeneous material like steel a crack once started is likely to go right through, whilst with a laminated substance like wrought iron there is an arrestation due to some providential cause; perhaps that surface-tension which is made to account for so many things we cannot otherwise explain. A short time ago there was another destroyer accident, through the fracture of a steel connecting-rod bolt, which gave way from the bottom of the thread just below the nut. This was doubtless due to a "tearing action," which, once started, there was nothing to stop. If a nut does not bed fairly and evenly on the surface against which it abuts, there is naturally a tendency on reversal of stress to bend the bolt, and if the bolt fits its hole exactly it cannot bend, and thus may be cracked across. For this reason some engineers make the hole larger than the bolt near the end, so as to afford a certain amount of give and take. But if we allow for all these points in favor of iron, we have yet the greater strength of steel to prevent the crack being started. A good many engineers go higher than Mr. Seaton when they have a free hand, 36- to 40-ton steel being used for some destroyers' engines, whilst the locomotive engineers go as high as 50-ton steel.

There is one circumstance that recent experience has brought home very forcibly, and that is how the introduction of the water-tube boiler has removed the source of anxiety from the stokehold to the engine-room. Formerly the danger with these excessively high-speed craft was nearly all with the boilers. The engines would take, with only ordinary precautions, all the steam the boilers could generate. Now it is not a question of getting steam, but of using it when supplied. If we were content to go back to our old speeds and old total weights of machinery, high-speed marine practice would be a very simple matter. However, we cannot afford to do that; unless other countries will agree to do the same we must still run risks, even such risks as those which led to the terrible calamity that overtook the poor fellows who lost their lives in the Bullfinch disaster.—*Engineering.*

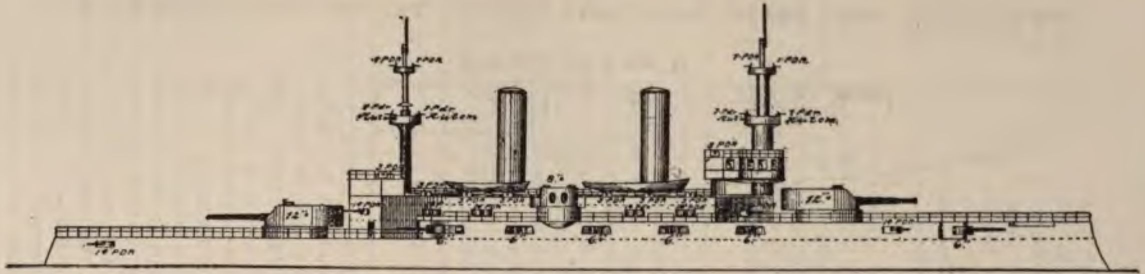
PROPOSED ARMAMENT FOR OUR THREE LATEST BATTLESHIPS.

By the courtesy of Rear-Admiral O'Neil, Chief of the Naval Ordnance Bureau, we are enabled to reproduce the accompanying plans, which were submitted to the Bureau of Construction as suggestions in regard to the armament and armor of our three latest battleships, New Jersey, Georgia and Pennsylvania, authorized by the last Congress. They show the many improvements which are possible on a given displacement as the result of the greatly increased resisting power of the latest type of armor and also as the result of the increased energy due to longer guns and higher velocities.

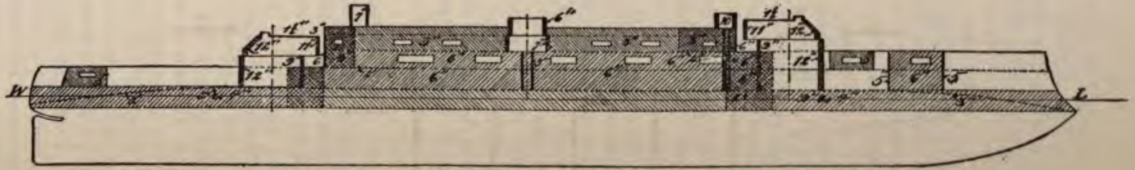
Our Construction Bureau has never turned out a more creditable design than that for the Alabama class of battleships, and we notice that in the successive designs, first of the Maine and now of the New Jersey class, the Bureau has wisely maintained the general distinctive features of the Alabama and merely added such improvements as were possible owing to the general advance which has been made in guns, armor and motive power.

Rear-Admiral O'Neil has prepared five separate plans for the new ships. They all possess the highly meritorious and characteristic features of carrying extremely powerful batteries and being provided with a very complete system of protection. While all of the designs are creditable, we must confess that the first of them, known as type A, of which we present two different views, appeals to us as being decidedly the most efficient, and containing the best combination and proportion of the different types of guns. The five designs are identical in displacement, speed and in the arrangement of the protective armor. Each plan, moreover, provides the same number of guns of each caliber and the same distribution in the secondary batteries, indeed the only modifications in the plans are those relating to the main battery in which are included the armor-piercing guns and the heavier rapid-fire weapons above 6 inches in caliber.

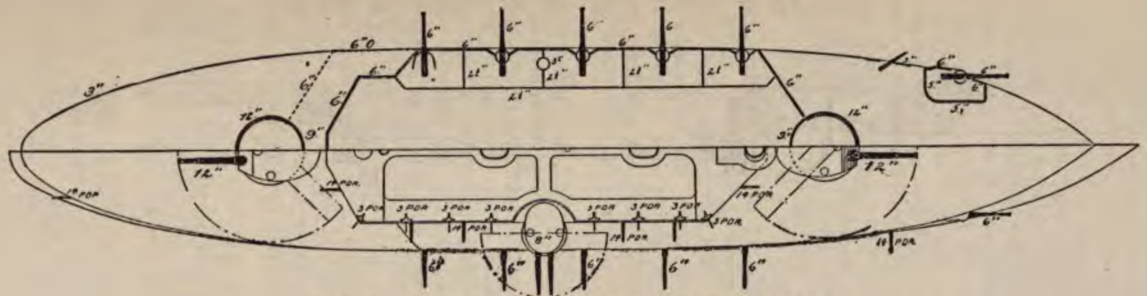
The distribution of the armor is in every way admirable, and is far more complete than anything that has yet been attempted in any of the navies of the world. In the first place, there is a complete water-line belt 8 feet in depth, which extends from stem to stern. It is 9 inches thick at its upper edge and carries this thickness for a depth of 4½ feet, from which level it tapers gradually to 6 inches at the lower edge. This belt maintains these thicknesses over that portion of the ship extending between the 12-inch turrets, and at its extremities transverse bulkheads, 9 inches in thickness, extend diagonally inward to meet the barbette armor of the 12-inch guns. From abreast of these barbettes to the stem and stern the water-line armor is gradually reduced to 4 inches in thickness. From the top of the water-line belt to the level of the upper deck, and extending forward and aft, as shown on the plans, the sides are protected by 6-inch armor, at whose ends are diagonal walls 6 inches in thickness, the whole forming a complete central casemate or redoubt, within which are placed ten of the 6-inch rapid-fire guns. Every 6-inch gun is further protected on both sides by splinter bulkheads 2½ inches in thickness, and each of these separate casemates is closed at the rear by bulkheads of 2½-inch steel. The 6-inch guns in the bow of the vessel on the main deck are each protected by a complete casemate 6 inches in thickness on the



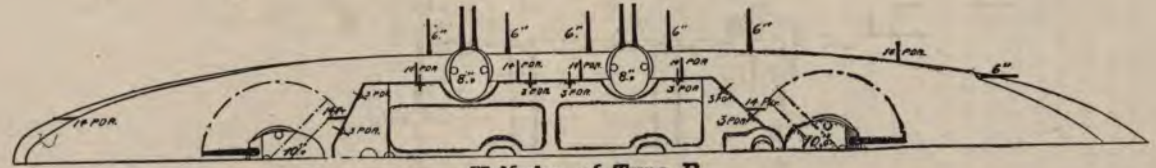
Side Elevation of Proposed Battleship, Type A.



Armor Protection for the Five Types of Battleship.



Half-plans of Upper and Main Decks, Type A.



Half-plan of Type B.

ALTERNATIVE PLANS FOR THE PROPOSED BATTLESHIPS OF THE "NEW JERSEY" CLASS.

outside, and with walls 5 inches thick in the interior of the ship. These casemates, like the main central casemate, extend from the protective deck clear to the upper deck. Above the central 6-inch gun redoubt there is another complete redoubt of 3-inch steel, within which is carried a battery of twelve 3-inch 14-pounder guns. There are also two 14-pounders on either bow on the main deck, just abaft of the 6-inch bow guns, while two others are placed on either quarter near the stern on the berth deck, all four of these guns being also protected by 3-inch armor.

The deck protection is also very complete. A protective deck, which is 2½ inches in thickness on the flat and 3 inches in thickness on the slopes, extends throughout the vessel. The deck above the central casemate or redoubt, in which the 6-inch rapid-fire guns are located, is to be of 2-inch plates at the extremities of these casemates, as shown in the accompanying armor plan. The barbettes for the 12-inch guns will be 12 inches in thickness outside the diagonal armor and 9 inches in thickness on the inside, while the turrets are to have 12 inches of armor for the inclined port plates, the sides and the rear plates are to be 11 inches, and the top plates 1½ inches thick.

Amidships, on each side of the vessel, are to be a barbette and turret for a pair of 8-inch guns, the barbette armor to be 7 inches and the turret armor 6 inches in thickness, while an 8-inch ammunition tube will extend down to the protective deck. Forward, above the 14-pounder battery, will be a conning tower with 10-inch armor and a 6-inch armored tube below leading to the protective deck, while aft, standing above the 14-pounder redoubt, will be a signal tower protected with seven inches of steel.

The armament will be extremely powerful. The main battery will consist of four 12-inch guns, 40-caliber guns each of 58,221 foot-tons energy, disposed in the two main turrets fore and aft; four 45-caliber 8-inch rifles, each of 13,602 foot-tons energy, disposed in the two turrets amidships on either beam; and twelve 6-inch 50-caliber guns each of 5838 foot-tons energy, carried in the closed central casemate and the two bow casemates on the main deck. The secondary battery will consist of sixteen 3-inch 14-pounder guns, sixteen 3-pounders, sixteen 4-shot automatic 1-pounders, six single-shot 1-pounders, ten machine guns, and two field pieces.

There is no ship afloat carrying a battery of such enormous energy as this, although by the time these three vessels are afloat—such is the rapidity of the development of naval armament—it is probable that they will be equaled, if not outmatched, by vessels already built or building in other parts of the world.

We welcome the return of the 8-inch gun. It proved itself to be the most efficient weapon used at Santiago and Manila, for although the hits were not as numerous as those made by the rapid-fire weapons of 6 and 5-inch caliber, the destructive effect was greater than that of any other type of gun carried in the war.

One of the plans herewith reproduced shows a modification in which there are eight in place of four 8-inch guns, arranged in four turrets, two on each beam. There are two other plans identical with this last except that one of them substitutes four 10-inch guns for the 12-inch, and the other substitutes two 10-inch and two 12-inch for the four 12-inch. In the second, third and fourth plans the fore and aft fire is the same as in the first plan, while the broadside fire is increased by two 8-inch guns. The fifth plan differs from all the others in having no 8-inch guns and in carrying sixteen instead of twelve 6-inch guns, eight of these firing on each broadside, four dead ahead and two dead astern. We think it is likely that the first of these designs will find most favor with our naval officers.

If, on a displacement of 13,500 tons, the Construction Bureau succeeds in building ships with this magnificent system of protection with such an unprecedented battery and with 18 knots speed, without reducing the necessary amount of stores, ammunition and berthing accommodation, it will produce by far the most effective battleship that the world has ever seen.—*Scientific American.*

THE SPEEDS OF BATTLESHIPS.

A service contemporary, in discussing the naval manœuvres, lays down as its opinion that the "subsidiary object" of the manœuvres is to test the value of speed in battle squadrons, and, of course, refers to speed as the essential thing for modern battleships. Everyone does this, or rather nearly everyone who writes about the matter, saving an isolated Frenchman or two. Americans, who used to hold that there were other things as important as speed, have now discarded the idea. The root of the axiom is that other axiom, that "the fleet of greater speed can seldom, if ever, be forced into action by a fleet of inferior speed."

Now, without posing as heretics, we cannot help thinking that, as things are, there is a good deal more to be said for the French case than on paper is at first sight apparent. And we believe that—confining the contention, of course, to reasonable limits—there is a large body of professional opinion more or less in line with the French idea. Speaking broadly, it is the amateur expert rather than the professional who preaches "speed is everything." The professional mind adds, "within reasonable limits," a clause that means nothing definite to the public side of the agitation for fast ships, but a very great deal to the main question, and merely paraphrases the latest French theory. It is a well-known fact that Whale Island is by no means wholly devoted to the Canopus class. Whale Island knows that an ordinary steel pointed 9.2-inch common shell has been through armor identical with that of the Canopus' belt. In theory such a hit, owing to the Canopus' system of protection, is not necessarily very dangerous, and it still leaves an intact thick deck, while there are also bunkers to localize the explosion. In actual fact there may be another side to the story. What a 9.2-inch common shell can penetrate, a 9.2-inch high-explosive is likely to get through, and its bursting and destructive power in that case is at least equal to a torpedo's, save for such localizing effect as the penetration of the armor may produce. Of course the case referred to was a remarkable experimental one, but at the same time it implies a strong possible vulnerability to the 9.4-inch and 10-inch guns carried by new German and Russian ships, unexpected, to a great extent, and to which the slightly slower Majestics are not liable. In return the Canopus gets, let us say, a knot better speed. Now, assuming the Canopus to be engaged with the Majestic, this means that in half an hour she could, whether the Majestic liked it or not, increase or decrease the range by 1000 yards. A thousand yards is not much, and hardly, we think, represents a range equal to that extra 3 inches, or, allowing for the better value per inch of the Canopus' armor, let us say 2 inches of armor. Again, what duel between modern ironclads is going to last half an hour? A three-knot difference, no doubt, would be another matter, and it might, apart from other things, confer the power to ram, which a one-knot difference certainly will not. Between being able to move a ship's length more in a fraction over a minute and in taking some four minutes to do so, the gulf is great. But to get ramming advantage out of even three knots in these days of gyroscopes and rapid-fire big guns seems a large risk. For the duel, in fine, the one knot extra speed seems useless, while even the as yet unobtained three-knot advantage seems a very doubtful gain if armor or guns have to suffer for it. The engines themselves, too, may stand to suffer. Such trouble as has come with warship engines has generally been due to a striving after lightness. In cruisers this may be accepted; a certain amount of "gingerbread" may be forgiven in a cruiser whose weapon is speed: a cruiser unit is not what a battleship unit is: a broken-down battleship may leave a mark upon the history of nations. "Make your engines strong and as powerful as may be" is not the same order as "Make your engines powerful and as strong as circumstances will admit." In the past the former has been our watchword: for the future the latter seems likely to oust it. If anything goes wrong—well, the makers of the engines or the engine-room staff are handy black sheep.

On this axle all the strategical advantages of the swifter battle squadron turn. If battleships gain their speed power by losing in guns or armor, their gain is nullified, since catching Tartars is of no supreme advantage strategically any more than tactically: while, if it is done at any expense of the engines, we have to face the question, Will the engines all stand it? To break a chief engineer and black-list a contractor will not remedy facts. We have noticed more than one indication lately on the part of the powers that be to realize this new use for engineer officers. Except for the engineer, it is a most brilliant idea—in peace time, but it will not answer in war.

To turn to the strategical value of the swifter battle fleet, we do not think the following facts are given their due weight when the question is thought out: the obvious, in fine, is given undue precedence of things less obvious indeed but equally weighty. There is no novelty about them; all have, at one time or another, been harped upon in our columns; all are patent upon consideration: but, as we remarked above, are prone to be overlooked. (1) If the enemy's ships put to sea, they will probably do so in order to fight, in which case guns and armor are of more value than speed. The theory of fleets seeking to effect combinations for ulterior objects is a general and classical one: but there is no valid reason why the necessary combinations should not be made *before* war begins. A war takes at least a month to begin now-a-days. (2) The theory of a fleet slipping out to combine with another is, therefore, overestimated. But, even if it did do so, it would be useless to catch it unless guns and armor were good enough to ensure victory. Also, so far as its *personnel* is concerned, the fleet that runs is a beaten fleet, and must deteriorate from the mere fact of running. The fleet it runs to join is also sure to be "watched," and it is difficult to conceive of two runaway fleets having sufficient speed to combine, re-form, recover *morale*, and attack one of the slower pursuers, before those pursuers are, to all intents and purposes, combined also. It is possible on paper, we know; but paper is not war. (3) In any chase certain ships of the runaway fleet are bound to drop behind, whatever speed difference there may be—this difference is never likely to much exceed two knots at the outside. The "lame ducks" must, therefore, be captured in detail, or the swifter runaway must turn and fight. (4) Generally speaking, the swift battleship has a coal supply that will run short before the slower vessel's. Her superior speed may, therefore, lure her to destruction in that way. (5) There is not a navy in the world that can put a homogeneous squadron into the field, except the British. A 15-knot squadron of homogeneous ships stands, when these are steaming together in station, to better a swifter fleet of varying units, because these last will not be able to perform evolutions together at a high speed. The amateur enthusiast for fast battleships is too apt to confound "station keeping" with cleanliness and polish. (6) Twelve knots is the highest speed at which fleet evolutions have yet been done, and that is recent. Admiral Rawson proposes to try 14 knots in the next Channel Fleet cruise; but that is possible only in a highly trained, regularly commissioned and homogeneous fleet. The least little error spoils everything. The only formations which a swifter hostile fleet could run away in would be loose line ahead or abreast; in both cases our cruisers would be able to concentrate on units, and to defend these units would entail slowing down and accepting battle.

There is one advantage of the runaway business—shooting from the after guns is always easier than from those forward; that is a tactical matter well known and to be adopted in general action by either side without regard to speed. A strategical position in which our ships needed to run away, and so incidentally availed themselves of this tactical advantage, is not easily conceivable. Very few admirals would dare to run, strategically; and did one do so, the damage to our prestige would be worse than a defeat. The *morale* of the man behind the gun is the dominant factor in naval warfare.

To a consideration of these points is due our regret at much of the present-day mania "for speed at all costs" for battleships. We believe, in fine, that the battleship should be a battleship, and the armored cruiser an armored cruiser. We are sceptical as to the use or need of any mean between a Majestic and an Asama; the former is better qualified for battleship work than the Canopus, and the Asama, frankly an armored cruiser, is better able to fulfill all cruiser work.—*The Engineer.*

STEAM TRIALS OF H. M. S. OCEAN.

The first-class battleship Ocean, which has been built at H. M. dockyard, Devonport, and engined by Messrs. R. W. Hawthorn, Leslie & Co., of Newcastle-on-Tyne, commenced her contract trials last week, as already stated in our report of the proceedings of the Institution of Mechanical Engineers at Plymouth.

This vessel is the first ship of the Canopus type to undergo her steam trials, and is also interesting as being the first battleship in H. M. service which has been tried with Belleville boilers, although, of course, many cruisers have passed through their trials fitted with this type of boiler. She is also of interest as being the first battleship of modern type which has ever been built at Devonport, although two other vessels, the Implacable and Bulwark, of this class are now in hand at that dockyard. The main propelling machinery of the Ocean consists of two sets of vertical three-crank triple-expansion engines. The diameters of the cylinders are 30 inches, 49 inches and 80 inches by 51 inches stroke, and the engines are designed to run at 108 revolutions per minute for indicating full power. All the cylinders of the engines are fitted with separate liners, the high-pressure cylinder being actuated by a piston valve, and the intermediate and low-pressure cylinders by double-ported slide valves. All the valves are worked by ordinary double-bar link motion. The bed-plates are of cast steel, the back columns being of cast iron, and the front columns wrought steel. The condensers, which are of cast gun-metal, have a total cooling surface of 14,500 square feet. All the auxiliary machinery usual in vessels of this class has been fitted.

The boilers, which are twenty in number, are of the Belleville type fitted with economizers, ten of the boilers having nine elements and ten having eight elements. The tubes, which are all of solid drawn steel, galvanized externally, are 4½-inch outside diameter in the generator elements, and 2¾-inch diameter in the economizer elements. The total heating surface is 35,715 square feet, of which 24,155 square feet are in the generator elements and 11,560 square feet in the economizer elements. The total grate area is 1035 square feet.

The boilers are arranged in three water-tight compartments, in two groups of eight and one group of four. The steam pressure is 300 pounds per square inch in the boilers, which is reduced to 250 pounds at the engines by means of Belleville reducing valves. The contract trials specified are as follows: (1) A preliminary trial at sea; (2) a thirty hours' trial at one-fifth power, *i. e.*, 2700 indicated horse-power; (3) a thirty hours' trial at 10,250 indicated horse-power; (4) an eight hours' trial at full power, viz., 13,500 indicated horse-power.

On July 26th the vessel was taken to sea for her preliminary trial, and the machinery was worked gradually up to about 100 revolutions. Everything worked without the slightest difficulty, and on the 27th the vessel proceeded to sea for her thirty hours' trial at one-fifth power. The results of this trial are tabulated below. The trial passed off most satisfactorily, no difficulties of any sort being experienced, the machinery running very smoothly without the slightest signs of heating. It will be noticed that the coal consumption is 1.84 per indicated horse-power. It should be mentioned, however, that the modifications which have been made to the auxiliary exhaust system in several recent ships, with such successful results in the matter of coal consumption, could not be carried out on board the Ocean without delaying the trials, and it was therefore decided that these modifications would be made after the ship was taken over. The further trials are being continued this week. The Engineer-in-Chief's department of the Admiralty was represented on the trial by Mr. Ellis, the machinery being in the charge of Mr. D. C. Beadon on behalf of Messrs. R. and W. Hawthorn, Leslie & Co.

MEAN RESULTS OF THIRTY HOURS' TRIAL.

		Starboard.	Port.
Mean steam in boilers		210	210
Mean steam at engines		184	184
Mean vacuum		27.8	27.5
Mean revolutions		66.6	67.0
Mean pressure in cylinders.	High	41.6	38.2
	Intermediate	16.2	15.4
	Low	4.6	4.2
Indicated horse-power.	High	506	466
	Intermediate	527	501
	Low	398	369
Total indicated horse-power		1431	1336
Gross total indicated horse-power		2767	
Coal per indicated horse-power		1.84	
Speed		11.4	

ON ELSWICK CRUISERS.*

By Mr. Philip Watts, Member of Council.

I purpose in this paper giving some particulars of Elswick cruisers built during the last ten years. In the Esmeralda, built in 1882-3 from designs by Mr. George Rendel, considerable advance was unquestionably made towards what may be called the modern protected cruiser. The features which it was sought especially to develop in the design of this vessel were—first, great speed and manœuvring power; secondly, exceptional power of attack; thirdly, protection other than by side armor. Lord Armstrong advocated this class of vessel in the early days of protected cruisers almost to the exclusion of armorclads, and before the introduction of high explosives there can be no doubt that such vessels were very much more on an equality with armorclads as fighting ships than they have been since.

Particulars of the Esmeralda are given in Table I. She was 270 feet long, of 2950 tons displacement. Her engines were of 6083 horse-power, and she attained a speed of 18.3 knots. Her armament consisted of two 10-inch guns, six 6-inch guns, and a number of smaller guns. Her machinery, magazines, &c., were wholly below the water-line, and were protected by an arched deck of 1-inch armor from stem to stern.

After the Esmeralda, the Giovanni Bausan was built, practically from the same designs, and later the Naniwa Kan, Dogali, Chih Yuan, and Ching Yuan were also built by my firm from designs by my predecessor, Sir William White. The Dogali was of 2050 tons displacement, some 950 tons less than the Esmeralda, but she steamed at 19.6 knots speed. Her armament consisted of six 6-inch guns and a number of smaller guns, and her armor deck, which extended from stem to stern, consisted of a central flat portion 1 inch thick and sloping sides 2 inches thick.

In Tables II and III are given the dimensions, particulars, armament, protection, &c., of a number of typical cruisers completed at Elswick during the past ten years, including those of the Piemonte, which were also given in my paper to this Institution at the spring meetings in 1889.

The vessels given in Table II have protective decks and no side armor; those in Table III have side armor. The Piemonte and Yoshino have each a poop and forecastle. The other two vessels on Table II, which are upwards of 4500 tons displacement, and the three vessels on Table III, which are upwards of 7000 tons displacement, are all flush-deck ships. The Piemonte had only a single bottom, as had also the 25 de Mayo and the 9 de Julio, but the Yoshino, and all other cruisers since built at Elswick, some five and twenty in all, have been provided with inner bottoms.

Machinery, speed, &c.—The vessels given on Table I were provided with horizontal engines, but all the vessels built by my firm during the past ten years, including those shown on Tables II and III, have had vertical engines wholly below the water-line. I believe the Piemonte, laid down in 1887, was the first cruiser built with vertical engines wholly below the water-line. The advantages of vertical engines had for some time been fully recognized. They could be more conveniently balanced and brought less strain on the ship's structure, were considerably lighter than horizontal engines, were subject to less wear and tear, and wear did not throw them out of truth to the same extent as in horizontal engines; with twin-screw engines they could also be got into much less space, especially in a fore-and-aft direction, and all the working parts were much more accessible. But difficulty had been found in getting them below the water-line, and where adopted in protected cruisers great weights of armor had to be expended in protecting the tops of the cylinders, which extended some feet above the water-line.

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* Read at the summer meeting of the fortieth session of the Institution of Naval Architects, July 19, 1899.

In the Piemonte my first intention was to have two or more sets of vertical engines upon each shaft, arranged in such a way that one set only could be used for economical steaming. But this arrangement involved some additional weight, and finally I found it possible to accept a single set of vertical engines of 27-inch stroke upon each shaft. Each set of engines had four cylinders, the low-pressure cylinders being divided into two, each expanding its own condenser. This enabled well-balanced, smooth-running engines to be provided, which have proved satisfactory in every respect. The particulars of these engines were given in my paper of 1889.

All the vessels given on Table II and on Table III have been engined by Messrs. Humphrys, Tennant & Co. They all have boilers of the ordinary cylindrical type, having a working pressure of 155 pounds per square inch, excepting the O'Higgins, which has been fitted with Belleville boilers. The boiler tubes in these vessels have been fitted with Messrs. Humphrys' patent tube connections.

In the Piemonte, as I have already stated, a stroke of 2 feet 3 inches was adopted, and 7050 indicated horse-power were realized on the trial with open stokeholds, and 12,780 indicated horse-power with forced draught. The number of revolutions corresponding to these powers were respectively 160 and 185, and the corresponding piston speed 720 feet and 832 feet per minute respectively. In the 25 de Mayo, 9 de Julio, and Blanco Encalada, the low-pressure cylinders were each 66 inches in diameter, and the stroke 2 feet 6 inches. In the Yoshino and Takasago the stroke was 2 feet 9 inches, and in the Buenos Aires the stroke was 3 feet, while in each of the vessels given in Table III, the Esmeralda, O'Higgins, Asama and Tokiwa, the stroke was 3 feet 3 inches. In all of these vessels and others, at full speed with open stokeholds, the number of revolutions varied from 155 to 185 per minute. In the Tokiwa, with open stokeholds, the engine developed about 15,000 horse-power, with about 145 revolutions, and a piston speed of about 940 feet per minute; and with less than 1½-inch air pressure in the stokeholds the engines developed upwards of 20,000 indicated horse-power, with about 160 revolutions and a piston speed of about 1040 feet per minute.

It may be remarked that with this quick-running machinery low powers may be developed more economically than in slower running machinery as they are developed in smaller engines. In this respect increased piston speeds and revolutions for full powers appear preferable to the increased boiler pressures which have been adopted in many recent vessels.

With reference to the speed of these vessels, our rule at Elswick has been to aim at giving half a knot more speed than we have undertaken by contract, and with one exception we have succeeded in doing this; the one exception being the case of two cruisers recently built for a distant country, in completing the contract for which our agent exceeded his instructions, and undertook to give the half knot we had in reserve. There were no penalties in the case, the purchasers only reserving the right of refusing the vessel in case a certain speed, considerably below the contract speed, should not be obtained; and as this minimum speed was not changed by our agent he had unwisely argued that our undertaking to give the additional half knot could make no possible difference to us. These two vessels at their official trials exceeded slightly their contract speed. The speeds given for the vessels in Table II are the means obtained over a number of hours. Natural-draught and open-stokehold speeds have usually been taken over six hours and forced-draught speeds have usually been taken over three or four hours. Curves of speed corresponding to revolutions have been constructed from data obtained by running the vessels over the Admiralty measured mile at the mouth of the Tyne, and these curves have been used in determining the speed over the four or six hours' run from the mean number of revolutions of the engines during these runs. Four consecutive runs with and against the tide have been made over the measured mile under the rules which hold for the British Navy. The Commissioners receiving the ships have taken the times of the runs and the revolutions of the engines. The times and revolutions on the runs have also been taken by my staff, the latter electrically against a time scale on a continuous sheet of paper passing over a cylinder.

In vessels from 3000 to 5000 tons displacement, a speed of about 21½ knots has been obtained with open stokeholds, and a knot or so more with forced draught. The 25 de Mayo, of 3100 tons displacement, obtained 21½ knots with open stokeholds, and 22.6 with forced draught. The 9 de Julio, of 3500 tons displacement, obtained 21½ knots with open stokeholds, and 22½ with forced draught. The Yoshino, of 4180 tons displacement, obtained 21.6 knots with open stokeholds, and 23 knots with forced draught. The Blanco Encalada, of 4560 tons displacement, obtained 21.7 knots with open stokeholds, and 22.8 knots with forced draught. Exceptionally high speed was provided in the Buenos Aires, of 4800 tons displacement; she steamed 23.2 knots with open stokeholds, but no official trial with forced draught was made.

The Piemonte, and some other vessels of less than 3000 tons displacement, have been provided with speeds lower than 21½ knots. The Piemonte herself, of 2500 tons displacement, attained a speed of 20.6 knots with open stokeholds, and 22.4 knots with forced draught.

Of the first-class cruisers given in Table III, the Esmeralda, of 7000 tons displacement, attained a speed of 23 knots with open stokeholds; the O'Higgins, of 8500 tons displacement, attained a speed of 21½ knots with open stokeholds; and the Tokiwa, of 9700 tons displacement, attained a speed of 20.9 knots with open stokeholds, and 23.1 knots with forced draught.

With reference to the manœuvring power of these vessels the resistance to turning has been reduced as much as possible, chiefly by the removal of the after deadwood, and in some cases of ships even exceptionally long and of deep draught, remarkable results have been obtained. In Table IV the diameter of the circles turned in by several of the vessels given in Tables II and III are recorded, together with the length of the ship over all, ratio of the diameter of the circle turned in to the length of the ship, and time required to turn through 180 deg. at full speed. Each of these vessels can turn in about 3½ lengths, and reverse their course in about two minutes.

We have received many reports on the steaming performances of our

TABLE I.

	Esmeralda.	Naniwa. Takachiho.	Dogali.	Chih Yuan. Ching Yuan.
Year of launch	1883.	1885.	1885.	1886.
Length between perpendiculars	270 ft.	300 ft.	250 ft.	250 ft.
Breadth, moulded	42 ft.	46 ft.	37 ft.	38 ft.
Draught, mean	18 ft. 6 in.	18 ft. 6 in.	14 ft. 6 in.	15 ft.
Displacement in tons	2950	3727	2050	2300
Indicated horse-power with forced draught	....	....	7179	6850
Indicated horse-power with open stokeholds	6083	7120	5012	....
Speed, in knots, with forced draught	....	....	19.66	18.5
Speed, in knots, with open stokeholds	18.3	18.77	17.68	....
Armament	Two 10-in. B. L. R. guns Six 6-in. B. L. R. guns Two 6-pdr. R. F. guns Five 37 mm. Hotchkiss Two Gardners	Two 10-in. B. L. guns Six 6-in. B. L. guns Two 6-pdr. R. F. guns Ten 1-in. Nord. Four Gatlings Four torpedo tubes	Six 6-in. B. L. guns Nine 6-pdr. Hotchkiss Six Gatlings Four torpedo tubes	Three 8-in. B. L. guns Two 6-in. B. L. guns Eight 6-pdr. Hotchkiss Two 3-pdr. Hotchkiss Eight 1-pdr. Hotchkiss Six Gatlings Four torpedo tubes
Protective deck—				
Thickness on slopes	1-in.	3-in.	2-in.	4-in.
Thickness, horizontal parts	1-in.	2-in.	1-in.	2-in.
Conning tower	1-in.	2-in.	2-in.	3-in.
Coal supply, normal	400 tons	350 tons	160 tons	200 tons.
Coal supply, bunkers full	600 tons	800 tons	480 tons	520 tons.
Nationality	Chilian	Japanese	Italian	Chinese.

TABLE II.

	Piemonte.	Yoshino.	Blanco Encalada.	Buenos Aires.
Year of launch	1888.	1892.	1893.	1895.
Length between perpendiculars	300 ft.	360 ft.	370 ft.	396 ft.
Breadth, moulded	38 ft.	46 ft. 6 in.	45 ft. 9 in.	46 ft. 6 in.
Draught, mean	15 ft.	17 ft.	18 ft. 5 in.	17 ft. 11 in.
Displacement in tons	2,500	4,180	4,568	4,788
Indicated horse-power with forced draught	12,786	15,750	14,500	....
Indicated horse-power with open stokeholds	7,050	10,320	9,500	13,293
Speed, in knots, with forced draught	22.3	23.0	22.8	....
Speed, in knots, with open stokeholds	20.41	21.6	21.7	23.20
Armament	Six 6-in. Q. F. guns Six 4.7-in. Q. F. guns Ten 6-pdr. Hotchkiss Six 1-pdr. Hotchkiss Four 10 mm. Maxim Three torpedo tubes	Four 6-in. Q. F. guns Eight 4.7 in. Q. F. guns 22 3-pdr. Q. F. guns Five torpedo tubes	Two 8-in. Q. F. guns Ten 6-in. Q. F. guns Twelve 3-pdr. Q.F.guns Ten 1-pdr. Q. F. guns. Two Gatlings Five torpedo tubes	Two 8-in. Q. F. guns Four 6-in. Q. F. guns Six 4.7 in. Q. F. guns 16 3-pdr. Q. F. guns Six 1-pdr. Q. F. guns Five torpedo tubes
Protective deck—				
Thickness on slopes	3-in.	4½-in. and 3½-in.	4-in. and 3-in.	3-in.
Thickness, horizontal parts	1-in.	1¾-in.	1¾-in.	1½-in.
Conning tower	3-in.	4-in.	6-in.	6-in.
Coal supply, normal	200 tons	350 tons	350 tons	350 tons
Coal supply, bunkers full	500 tons	1000 tons	866 tons	1000 tons
Nationality	Italian	Japanese	Chilian	Argentine

TABLE III.

	Esmeralda.	O'Higgins.	Asama. Tokiwa.
Year of launch	1896.	1897.	1898.
Length between perpendiculars	436 ft.	412 ft.	408 ft.
Breadth, moulded	52 ft. 5 in.	62 ft. 9 in.	67 ft.
Draught, mean	20 ft. 6 in.	22 ft.	24 ft. 4 in.
Displacement in tons	7,000	8,500	9,700
Indicated horse-power with forced draught	....	....	20,550
Indicated horse-power with open stokeholds	16,020	15,930	14,718
Speed, in knots, with forced draught	....	....	23.09
Speed, in knots, with open stokeholds	23.03	21.48	20.87
Armament	Two 8-in. quick-firing guns Sixteen 6-in. " " Eight 12-pdr. " " Ten 6-pdr. " " Four Maxims Three torpedo tubes (above water)	Four 8-in. quick-firing guns Ten 6-in. " " Four 4.7-in. " " Ten 12-pdr. " " Ten 6-pdr. " " Four machine guns Three torpedo tubes (two submerged)	Four 8-in. quick-firing guns Fourteen 6-in. " " Twelve 12-pdr. " " Seven 2½-pdr. " " .... Five torpedo tubes (one forward, armored, and four submerged)
Protective deck—			
Thickness on slopes	1½ in. to 2 in. at ends	1½ in. to 3 in. at ends	2 in.
Thickness on horizontal parts	1½ in. to 2 in. at ends	1½ in. to 2 in. at ends	2 in.
Conning tower	8 in.	9 in.	14 in.
Armor—			
Belt (length)	328 ft.	260 ft.	414 ft.
Belt (width)	7 ft.	7 ft.	7 ft.
Belt (thickness)	6 in.	7 in. and 5 in.	7 in. and 3½ in.
Bulkheads	6 in.	5 in.	3½ in.
Citadel (length)	....	....	260 ft.
Citadel (thickness)	....	....	5 in.
Barbettes	....	....	6 in.
Casemates	....	6 in.	6 in.
Coal supply, normal	550 tons	550 tons	600 tons
Coal supply, bunkers full	1300 tons	1200 tons	1200 tons
Nationality	Chilian	Chilian	Japanese

TABLE IV.—*Turning Circles.*

Vessel.	L. Length of under-water body.		D Diameter of circle.	Ratio $\frac{D}{L}$.	Time to turn through 180 deg.	
	ft.	in.	ft.		min.	sec.
Yoshino	388	0	1205	3.1	1	54
Blanco	398	0	1275	3.2	2	5
Ministro Zunteno	355	0	1145	3.23	1	50
O'Higgins	446	0	1540	3.45	2	6¼
Asama	442	0	1470	3.33	2	6

ships during the past ten years, and without any exception they have been of a most encouraging and satisfactory nature. In some cases speeds exceeding those attained on trial have been reached, and long distances involving many days' steaming have been frequently traversed at full speed. One naturally looks to the stress of war for bringing to light defects in warships, but although we have learnt a great deal from recent wars, the steaming performances of the ships have always been most highly spoken of. Admiral Ito, who commanded during the recent war between Japan and China, wrote us: "In no less a degree do I recognize the important part played by the ships which were built in your yard, and I cannot here miss the opportunity of expressing to you and to my friends at Elswick my high sense of admiration for the behavior of these magnificent cruisers. Throughout this war they have never failed to fulfill our strictest expectations, and they have been of immense service to us in executing the manifold duties of a modern naval operation." With reference to Yoshino, Admiral Tsuboi, whose flag she bore during the war, has since unfortunately died, but Admiral Dewa, who was Chief Staff Officer of the Flying Squadron during the war, states that being "the fastest vessel in the fleet, and being armed with quick-firing guns and smokeless powder, she was taxed to the uttermost throughout the whole war, and performed numerous long-distance runs extending over many days at speeds of 21 knots and upwards, and the machinery never failed or gave trouble or anxiety on any occasion."

Armaments.—The Piemonte was the first ship provided with quick-firing guns, and with her powerful main armament of six 6-inch guns and six 4.7-inch guns her power of attack was at the time greater than that possessed by any other cruiser afloat, and many other vessels of twice her size. The Yoshino, 9 de Julio, and several other vessels were provided with similar armaments, while the main armaments of the 25 de Mayo, Blanco Encalada, and Buenos Aires include two 8-inch guns. The Blanco Encalada carries also ten 6-inch guns, and the Buenos Aires four 6-inch guns and six 4.7-inch guns. All of these vessels carry also a large number of smaller guns, and all carry five above-water torpedo-tubes excepting the Piemonte, which carries only three. The whole of the main armament is in each case carried on open decks, the gunners being protected only by strong shields carried on the guns themselves.

Passing to Table III, the armaments of the vessels here shown are still heavier. The Esmeralda, of 7000 tons displacement, carries two 8-inch quick-firing guns, sixteen 6-inch quick-firing guns, eight 12-pounder quick-firing guns, ten 6-pounder quick-firing guns, four Maxims, and three above-water torpedo-tubes.

The O'Higgins, of 8500 tons displacement, carries four 8-inch quick-firing guns, ten 6-inch quick-firing guns, four 4.7-inch quick-firing guns, ten 12-pounder quick-firing guns, ten 6-pounder quick-firing guns, four machine guns, two under-water broadside torpedo-tubes, and one above-water torpedo-tube.

The Asama and Tokiwa, of 9700 tons displacement, carry four 8-inch quick-firing guns, fourteen 6-inch quick-firing guns, twelve 12-pounder quick-firing guns, seven 2½-pounder quick-firing guns, four under-water broadside torpedo-tubes, and one above-water armored torpedo-tube.

The whole of the guns of the Esmeralda are carried on the upper deck, except two 6-inch guns carried upon a spar deck forward, and two 6-inch guns carried upon a spar deck aft, and four 12-pounders, two forward and two aft, on the main deck. The arrangement is such that one 8-inch gun can fire all round the bow from 45 deg. abaft the beam on one side to 45 deg. abaft the beam on the other side, and the other 8-inch gun can fire all round the stern from 45 deg. before the beam on one side to 45 deg. before the beam on the other side. All the 6-inch guns are placed on the broadside, but four of them, including the two on the spar deck forward, can fire directly ahead and 5 deg. across the bow, and four of them, including the two on the spar deck aft, can fire directly astern and 5 deg. across the stern. The gunners are protected only by gun shields carried by the guns themselves.

In the O'Higgins, the four 8-inch guns and four of the 6-inch guns are carried on the upper deck in gun-houses, which completely protect the gunners and the gun mounts, and the remaining six of the 6-inch guns are carried on the main deck in casemates. The gun-houses and casemates of the 6-inch guns have 6-inch fronts and 5-inch backs, and the gun-houses of the 8-inch guns have 7-inch fronts and 5-inch backs. Two of the 8-inch guns are placed on the middle line, one forward and one aft, with arcs of training as in the Esmeralda, the other two are placed on the broadside, with arcs of training from right ahead to some 50 deg. abaft the beam. The two aftermost 6-inch guns in gun-houses have similar arcs of training, *i. e.*, from right astern to 60 deg. before the beam. Of the 6-inch guns in casemates on the main deck two can fire directly ahead and two can fire directly astern. Two of the 4.7-inch guns are mounted on a spar deck forward; the other two are similarly mounted aft. There are thus: three 8-inch guns, two 6-inch guns and two 4.7-inch guns, besides a number of smaller guns which can fire directly ahead; and one 8-inch gun, four 6-inch guns, and two 4.7-inch guns, besides a number of smaller guns which can fire directly astern; and three 8-inch guns, six 6-inch guns, and two 4.7-inch guns, with a number of smaller guns, can fire on either broadside.

In the Asama and Tokiwa, two 8-inch guns are twin-mounted on the middle line forward in a strong gun-house of 6-inch armor, with an arc of training around the bow of from 40 deg. abaft the beam on one side to the same angle abaft the beam on the other side, and the other two 8-inch guns are similarly mounted aft. Four of the 6-inch guns are mounted on the upper deck in 6-inch armored casemates, six are mounted on the main deck, also in 6-inch armored casemates, and the remaining four are mounted on the upper deck in the open, the gunners being only protected by the gun shields. Four of the 6-inch guns can fire directly ahead and four directly astern. Thus in these vessels two 8-inch guns in pairs and four 6-inch guns can fire directly ahead, and two 8-inch guns in pairs and four 6-inch guns can fire directly astern, and the four 8-inch guns in pairs and seven 6-inch guns can fire on each broadside, besides which there are six 12-pounders and two 2½-pounders able to fire directly ahead, and similar guns able to fire directly astern, and six 12-pounders and two 2½-pounders capable of firing on either broadside.

Protection.—The thicknesses of the armored decks in the vessels given in Table II vary from ·1 inch to 1¾ inches on the horizontal portions, and from 3 inches to 4½ inches on the sloping portions. In a fully-equipped condition the horizontal parts of the decks would lie from 1 foot to 18 inches above the water-line, and the sloping portions would extend to from 3 feet to 4 feet below the water-line. Most of the vessels in this class have been provided with 6-inch conning towers.

On the introduction of high explosives, and after the experiments on the resistance in penetration, it appeared to us very desirable that cruisers should be provided with side armor at least at the water-line, and the 25 de Mayo, which was then building as a stock cruiser, was altered so as to carry a belt of side armor extending from the lower edge of the sloping deck armor to 3 feet above the water-line. Her purchasers, however, elected to have her completed as originally contemplated.

In the cruisers given on Table III side armor has been provided. The Esmeralda has a 6-inch belt extending over three-quarters of her length amidships 7 feet wide, the O'Higgins has a belt over two-thirds of her length 7 feet wide and 7 inches thick, and the Asama and Tokiwa have belts over their entire length 7 feet wide and 7 inches thick, but tapered to 5 inches at the extremities. Each of these vessels is also provided with a strong protective deck from stem to stern.—*The Engineer.*

THE BLAKE.

Among the ships enumerated in an approximate summary of the shipbuilding and marine engineering work executed on the Thames within the past twenty-one years, given in our issue of December 30th, 1898, two vessels were mentioned, which it was our intention to have more fully noticed had not other pressing matter had claims on our space at the time. The vessels alluded to are H. M. first-class cruisers Blake and Blenheim, sister ships: the first-named, built at Chatham, and engined by Messrs. Maudslay, Sons & Field, of Lambeth; and the second, at Blackwall, by the Thames Ironworks and Shipbuilding Company, and engined by Messrs. Humphrys, Tennant & Co., of Deptford.

The internal arrangement and economy of a modern cruiser, though not of the very latest type, will be interesting to many of our readers not conversant with the details of ships in general, or those of warships in particular. We are glad therefore to be able to give them, through the courtesy of Messrs. Maudslay, Sons & Field, a description of H. M. S. Blake, the elder of the two sister ships before referred to; a vessel which, at the time she was designed, was the largest and most powerful unarmored cruiser ever proposed to be built for the British Navy; and to explain briefly the purposes which each of the compartments serves in the general economy of the ship. In what follows it will be understood that our descriptive matter applies equally to the Blake and Blenheim, they being built from the same lines, of the same kind of material, and fitted in every way in a similar manner.

Before entering, however, into the details of the internal arrangement of the ship, it is necessary that her principal dimensions, &c., should be stated, to enable the reader to appreciate the work which devolved upon her designer in providing within limited dimensions and displacement the necessary structural strength to make the ship an efficient fighting machine, adequate space for her propelling machinery and its adjuncts, room for the safe and proper stowage of ammunition, stores,

&c., together with sufficient accommodation for the berthing of the whole of her officers and crew.

In the early part of April, 1888, instructions were issued for preparations to be made at Chatham Dockyard for the construction of a new type of first-class cruiser, designed by the Chief Constructor of the Navy—the present Sir W. H. White, C. B.—which was to surpass in speed, coal endurance, protection and armament anything ever before attempted. The dimensions to be given to this vessel were: Length between perpendiculars, 375 feet; breadth, extreme, 65 feet; loaded displacement, 9000 tons; with a mean water draught of 25 feet 9 inches. No such ship had been added to the British Navy since the date—1861—of the Warrior. She was to be constructed of steel, without side armor; but her vital parts were to be protected by a curved steel deck extending the entire length of the ship, and she was to have propelling machinery, driving twin screws of 20,000 indicated horse-power, to enable her to attain a continuous steaming speed at sea of 18½ knots an hour, or 22 knots at full power on the measured mile.

From the foregoing particulars of requirements, readers will not be surprised to know that in length, tonnage, displacement and propelling power the Blake was 75 feet longer than any of the belted cruisers then existent, had 4000 tons more displacement than any previous vessel of her class, and her engines were fully 8000 horse-power in excess of those of a first-class battleship of her date. The tender for the construction of her machinery, by Messrs. Maudslay, Sons & Field, was accepted in August, 1888, and the vessel was launched at the end of November, 1889.

As the hull of the Blake—which is of soft steel—in its structural arrangements, calls for first notice in our brief description of the vessel, it will be seen that it is constructed on the cellular system, is double-bottomed, and is internally subdivided by a number of athwartships water-tight bulkheads. There are four principal decks, viz., upper, main, protective and lower decks. The protective deck, shown by a white line extending from end to end of the vessel, curving downward, forward and aft at the ends is of turtle-back form, and slopes down at its side edges to 6½ feet below the load water-line, while its high part on the middle line of the ship is 1½ feet above the water. On the slopes of this deck, which it will be seen is supported by deep beams for the length of the machinery and boiler space, the steel of which it is constructed is 6 inches thick, while on its flat parts the thickness is reduced to 3 inches; this protection being practically stronger than that of any then existent cruisers with similar decks, and comparing favorably with the deck protection of many foreign battleships of very much greater displacement. No side protection in the shape of thin armor was given to the ship, as it had been experimentally proved that even 4-inch armor was still penetrable by shells carrying high explosive charges.

We may at this point in our description state the armament and kind of guns the ship carries, with their disposition on board. The armament consists of two 9.2-inch 22-ton and ten 6-inch 5-ton heavy guns, with sixteen 3-pounder quick-firers, and seven machine guns. The two 22-ton guns are carried on the upper deck, one forward and one aft, to serve as bow and stern chasers, having each an arc of fire of about 240 deg. Six of the 6-inch 5-ton guns are carried on the upper deck, two of them firing right ahead, two right astern, and two on the broadsides; the midship pair firing through an arc of 120 deg., or 60 deg. before and 60 deg.

abaft the beam. The remaining four 6-inch guns are carried on the main deck, two on each broadside.

In addition to the armament above detailed, the Blake is fitted with two submerged torpedo-discharging tubes, and has her stem made with a formidable ram. As she has no external keel, it will be noted that the under-water part of her bow is gradually curved upward from the bottom, until it meets the end of the ram; and that at her after ends the deadwood, as it is called in a wooden ship, is partially cut away for some distance forward to facilitate and improve the steering and turning capabilities of the vessel. Both these features are considerably more pronounced in our latest warships. It will also not escape notice that the Blake is fitted with a balanced rudder of fairly large area, good turning power on her hull being thus ensured, without a large force being necessary to maintain the rudder in position. With her double bottom, protective deck, and the numerous bulkheads in the ship, most of which are carried up to the main deck, all made perfectly water-tight; it was considered that together they would maintain the buoyancy of the vessel should she be seriously damaged by grounding or in action. And with a view to still further protection of her most vital parts, included within the machinery space, which occupies nearly two-thirds of the length of the ship, she is shielded by coal at her sides, as well as over the slopes of her protective deck within the same length.

Internally, below the upper deck, the ship is practically divided lengthwise into four principal compartments, separated by transverse bulkheads; the first extending from inside the bows to the forward boiler-room bulkhead; the second, from this point to the forward engine-room bulkhead; the third is the space included between the forward and after engine-room bulkheads containing the propelling machinery; the fourth compartment extending from the last-named bulkhead to the extreme after part of the ship.

In reference to the first or forward main division of the ship, its lowest depths, above the water-tight platform, are principally appropriated to the small-arms magazines for the stowage of ammunition; the compartments into which this space is subdivided by transverse partitions, or bulkheads, being capable of being instantly flooded in case of fire. In the space above the magazines between the lower and protective decks, the machinery and engines for working the capstan and windlass gear are fixed, and aft of this are the shell and torpedo-rooms. Above the protective deck, and between it and the main deck, are seen the storerooms, chain cable locker, washing-room, &c., and on the main deck are shown the interiors of the forecastle, store and mess-rooms.

As the two intermediate compartments of the ship are her most vital parts, and require fuller notice, we defer description of them until we have briefly shown how the fourth, or after compartment of the ship, is appropriated.

That part of the vessel immediately adjoining the after engine-room bulkhead, below the level of the lower deck, and between it and the water-tight flat, is, in the space between the two propeller shaft passages, as far aft as the stuffing-box bulkhead, utilized as magazines; the remaining part aft of that bulkhead being used for water ballast. The sides of the shaft passages, or tunnels, in which the thrust blocks are fixed, are made to serve the purpose of storing the spare gear for the main engines. Immediately above this part of the ship on the lower deck, are the after magazines and shell-rooms, and joining these still further aft, the steering engine and tiller-rooms. On the protective deck above the magazine and shell-rooms, and near to the after engine-room bulkhead, is the engineers' workshop; the space on this deck further aft being occupied by stores. On the main deck over the engineers' workshop are the engineers' mess-room and cabins; and on the same deck further aft the executive officers' ward-room with cabins at the sides; the state-rooms of the officer in command of the ship being the farthest aft.

Directly forward of that compartment of the ship just briefly described is the one devoted entirely—below the protective deck—to the propelling machinery of the vessel. This compartment, as a whole, is divided by a middle line and two transverse bulkheads into four separate engine-rooms, each water-tight in itself, and containing a set of three inverted cylinder triple-expansion engines, so arranged that each two sets on the starboard and port sides respectively can be coupled together for driving each propeller; or, in case of damage to one set, it can be disconnected from the others, and so localize the injury sustained.

The type of engines, although favored by one foreign government, was as remarkable among previous marine engines in our own navy as the ship was among its ships, they being the most powerful hitherto applied to the propulsion of a man-of-war. The cylinders of each set were 36 inches, 52 inches and 80 inches diameter for high, intermediate and low pressures respectively, all with a piston stroke of 4 feet. Each set of engines has an air pump 33 inches diameter and 2 feet stroke; and a brass surface condenser with 2250 square feet of tube cooling surface; the cooling water is supplied by a centrifugal pump with a 3-foot 9-inch diameter impeller, driven by an independent engine, the pump being adapted to draw either from the bilge or the sea. Each two sets of engines drive an 18-foot 3-inch diameter screw propeller, having a mean pitch of 24 feet 6 inches.

The protective deck covering the engine space is dome shaped, and rises to a sufficient height above the cylinder tops to allow of their covers being removed, it being for protection at this part from 6 inches to 8 inches thick. The four engine-rooms are kept cool by air fans 4 feet 6 inches in diameter, the air being carried below by the cowl-surmounted ventilators. Above the machinery, and between the main and upper decks, the space is occupied with galley, bake-house, pantry, &c. &c.

Immediately adjoining the forward engine-rooms is the boiler, or steam-generating compartment of the ship; this, it will be seen, is bounded at either end of its length by athwartship coal bunkers, which, being connected to those at the ship's sides at this part afford great protection to its contents. This comprises six double-ended four-furnaced cylindrical return-tube boilers, and one auxiliary single-ended boiler. The double-ended boilers, designed for a working pressure of 150 pounds per square inch, are each 15 feet 2 inches diameter and 18 feet long; placed side by side, and fired fore and aft; the auxiliary boiler for supplying steam to all the auxiliary engines in the ship—about sixty in number—being 10 feet diameter and 9 feet long; the total heating surface in the main boilers being nearly 27,000 square feet, with 863 square feet of fire-grate; the heating surface in the auxiliary boiler being 900 square feet.

Each set of three main boilers, it will be noticed, is in separate boiler-rooms, divided from each other by transverse bulkheads; the small boiler being located between these. The products of combustion are carried off from each triplet of boilers by one funnel, that from the small boiler being led into the uptake of the after set, ample air being supplied to the stokeholds by the cowl-mounted ventilators; the ventilator shafts serving also for conveying the waste ashes to the upper deck by means of the ash hoists fitted to them. For the attainment of high speed for which the ship was designed, the main boilers are fitted for the application of forced draught to the furnaces with closed stokeholds, twelve fans, 5 feet 6 inches diameter, driven by independent engines, being supplied for that purpose. The coal bunker capacity of the ship is 1500 tons—one-sixth of her load displacement—sufficient to enable her to cover a distance of 15,000 knots at a ten-knot speed.

Having briefly described the internal arrangement of the Blake below decks, we have now to note the few erections, &c., to be found upon her upper deck, and the appliances for handling the boats, &c., carried by the ship. With the exception of the slightly raised forecastle deck forward, the upper deck of the ship is flush from end to end. Upon it, at what is known as the "break of the forecastle," the most important erection is the "conning tower," having above it the upper and lower forward bridges. This tower, which has its foundation below on the protective deck, though not a large, is a massive structure, usually circular in form, made of rolled steel plate, some 12 inches thick, above the upper deck, diminishing in thickness towards its base. From this tower is seen all that is taking place on deck and around the ship when in action; and it contains within it all the necessary means of communication with the different stations in the vessel for controlling her when under fire. On the lower bridge, directly over the conning tower are the bridge telegraph, the binnacle, wheel and chart houses. The ship has two steel pole masts with flag topmasts, but no sail power, with the exception of a fore staysail for steadying purposes. Both masts are fitted with derricks, the after one being a substantial spar used for hoisting in and out, the steam vedette boat and pinnace carried in chocks on the deck.

A flying gangway connects the forward and after bridges, the latter having on it a chart house with signal flag lockers, &c. Directly aft of this bridge is a small director tower, with sighting holes for torpedo-firing purposes. The only other erections on deck, though not fixed ones, are the armored shields for the two big guns, these being semicircular in form with sloping roofs; the guns being on the central pivot system. The shields move with them when being trained. In addition to the two large boats carried inboard, the Blake has ten others, carried in davits along her sides. Electricity supplies light throughout the ship, it being generated by three Siemens dynamos, driven by a Willans engine, each capable of producing a current of 400 ampères.

Although the power developed by the Blake's engines on the forced-draught trial did not quite come up to that contracted for, that given out by them under natural draught exceeded the contract—14,000—by as much as 1525 indicated horse-power, with less than the Admiralty limit—½ inch—of air pressure. On the mile, the speed realized by the ship was less than was anticipated in proportion to the power developed by the engines, but with the actual air pressure used on the natural draught trial—.42 inch—the boilers worked remarkably well.—*The Engineer.*

THE LAUNCH OF THE KAISER WILHELM DER GROSSE.

This vessel is one of the group of three great turret ships building for Germany, namely, the Kaiser Friedrich III, Kaiser Wilhelm der Grosse, and the König Wilhelm (Ersatz). The table herewith shows the dimensions and principal data of the vessel in question. The thicknesses of the belt and turret armor, however, have been slightly altered in accordance with information received from Germany. It will be seen that the vessel is an extremely formidable first-rate line-of-battle ship. The special features are great speed and energy of fire. In our judgment her protection is open to objection. At the same time only actual trial would test this. Her belt of 12-inch Krupp armor is abundantly strong, and with her curved deck protects her vital parts beneath thoroughly well. The upper structure has, however, very little protection beyond the actual gun positions, and could be riddled with common shell. The German contractors have accepted this liability no doubt, making provision against serious fire by the removal of all wood. It would be interesting to see what common shell would effect. We question if the structure supporting the gun positions would not become injured and distorted by shell bursting beneath them, but to this the contractors no doubt have some reply. About the 18 knots speed there can be no two opinions. It agrees with what we have laid down for our largest 15,000-ton battleships, that is, the Bulwark, Implacable, Irresistible and London. The energy of fire is nearly as great as that laid down for any ship, that is, about 577,000 foot-tons per minute, or 53 foot-tons per ton displacement.

The first ship of this class completed was the Kaiser Friedrich III, which when tested at Wilhelmshaven on October 30th last easily made her 18 knots stipulated speed, with 13,500 indicated horse-power and 115 revolutions, although in a heavy sea and strong wind. The grouping of the guns and disposition of the armor are half French and half British. The belt is complete, and, as above said, the price is paid for it in absence of protection to the upper part of the hull. This, and the small single turret gun position on the broadside, are French. On the other hand, the curved deck and large double-gun turrets were originally British features, and some of the 15-centimeter quick-firing guns are in positions closely resembling Sir W. White's casemates. It is interesting to watch in the various designs of battleships the great uncertainty as to whether to adopt what we may term the French or British grouping. The French and British designers hold firmly to their own systems. No British ship can be found with her guns grouped in any sense like the French; we may look through our designs in vain for the little single-turret mountings. No French ship has anything like our casemates. This distinctive line is rarely found in other navies. Russia was apt to surround her secondary armament with a single-armored wall, with a marked absence of steel traverses and divisions, but in the Poltava class the heavy quick-firing guns are in small double turrets. The newer Japanese designs are distinctly British, except that in the Mikasa, building at Barrow, of 15,200 tons displacement, the largest battleship in the world, the quick-firing gun casements have no intervals between them, thus forming a continuous wall, for which, we think, there is much to be said. The United States armaments have been grouped rather on the French system, while the armor, forming a belt of limited length in combination with horizontal armor at the ends and the side plates over the belt, is British. Germany has followed France in the complete water-line belt and grouping of armament generally, although in this class we now see some approach to the British casemate and the curved deck.

Finally, we may remark that the Kaiser Friedrich der Grosse class marks the existence in service of the Krupp thick armor, which has given the remarkable results that have caused the adoption of this armor in all important navies. It was with this class of plate that Krupp obtained the record figure of merit of 2.33; that is to say, a resistance equal to that of 2.33 times the plates' thickness in wrought iron; so that this ship's 12-inch, or possibly 11.8-inch of Krupp steel may be equivalent to about 28-inch or 27.5-inch of iron. As our readers are aware, the German Navy is likely to be increasingly furnished by Krupp.

KAISER WILHELM DER GROSSE, GERMAN FIRST-CLASS BATTLESHIP.

Length	377 ft.	
Beam	67 ft.	
Draught	26 ft.	
Displacement	10,955 tons.	
Motive power	13,000 H. P.	
Speed	18 knots.	
Coal supply	640 tons.	
Armament—		
4 24 cm. (10-in.)		Quick-firing guns.
18 15 cm. (6-in.)		
12 8.8 cm. (3$\frac{5}{16}$-in.)		
12 3.7 cm. (1$\frac{15}{32}$-in.)		
8 0.8 cm. ($\frac{5}{16}$-in.)		Machine guns.
Torpedo armament—		
1 under-water bow tube	53 cm. (21-in.)	
4 " broadside tubes	46 cm. (18-in.)	
1 above-water stern tube	46 cm. (18-in.)	
Armor—		
Belt	12-in.	
Curved armor deck	3-in.	

MERCHANT STEAMERS AND WAR REQUIREMENTS.

*On the Practicability of so Constructing Merchant Steamers as to Render them Readily Available for War Purposes.**

By JOHN HARVARD BILES, M. Inst. C. E.

The two purposes for which merchant steamers may be used by the navy in time of war are: (1) armed cruisers; (2) auxiliaries for supplying a fleet with necessaries and as troop transports.

For the former purpose they may have to fight cruisers; for the latter, they will frequently require protection from either armed mercantile cruisers or regular warships, but their ability to do the duty is undoubted, and need not be discussed.

Obviously as armed cruisers vessels must have considerable speed, and their numbers are in consequence limited. Lloyd's gives the following:

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* Paper read before the Engineering Conference of the Institution of Civil Engineers. Section V, Shipbuilding.

20 knots and upwards	43
19 " "	35
18 " "	48
17 " "	83
16 " "	77
15 " "	128

Slower vessels will probably not be used as armed cruisers. Those speeds appear to be in most cases sea speeds. Some of the larger vessels have coal-bunker capacity, exclusive of holds, sufficient to enable them to steam for from 10,000 to 12,000 knots at 10 knots speed.

We may reasonably assume that vessels of this character are better able to maintain their speed at sea than warships. Their every-day business is to run at some speed called full speed, and most of them do not run at any other speed. It does not follow that they cannot steam easily at lower speeds, but a ship which ordinarily does not steam at full speed is more likely to fall short of maintaining full speed over long periods than one which is in the habit of doing it.*

In consequence, merchant ships have been considered to be most suitably used as scouts or despatch boats, and no attempt has been made to give them an armament equivalent to warships of anything like their size, power, and speed. Some of the results or arming and fighting the mercantile cruisers of the United States Navy seem to point to the ability of these vessels to cope with thoroughbred warships.

One point is deserving of consideration. Is there not a considerable value in a floating structure, whether it is subdivided and protected as a warship, or has no more subdivision nor protection than a tramp? It floats, and it offers considerable resistance to sinking, whatever kind of ship it is. Does not the result of modern sea-fighting point to the conclusion that a ship is more likely to be disabled by her crew being driven from their guns than from her being sunk from the effects of shell fire? If this is so, the extra subdivision and protection of buoyancy and stability of a warship over a merchant ship may not be called into play, and the fight between the two will become one of guns *versus* protection of gunners. This leads to the consideration of the question of portable protection for gunners in the merchant ship.

In the first-class cruisers, casemates are built into the ships. These would be impracticable in a merchant ship. But guns with shields are portable enough, and would place a merchant ship in a very favorable position compared with a second-class cruiser, as her size and deck area allow her to mount a much larger number of guns. In a paper which I read in 1894 before the Institution of Naval Architects, I endeavored to show how large mail steamers could be made as fit to fight as many first-class cruisers. Portable side armor was proposed, which should be ready for bolting on in time of war. If this system were adopted for the protection of guns, by placing them in a box battery, as the Americans have done and the Japanese are doing in the ship Mr. Dunn has designed for them at Barrow, a considerable number of guns could be mounted, which could be as well protected as in first-class cruisers. This subject is, however, too detailed to be discussed here, but it is not an impracticable operation to have portable armor put on a mail steamer.

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*In the recent Spanish-American war the cruisers St. Louis and St. Paul, New York and Paris, could steam at 4 knots with the main throttle shut by the use of the exhaust steam of the auxiliary engines only. About thirty tons per day is the necessary consumption on auxiliaries, and the exhaust steam was sufficient to propel the ship at 4 knots and keep the machinery ready for immediate increase of speed to 20 knots. Eight minutes is the time given by the engineers as sufficient to make this change.

The work done by the American line steamers in the recent war included scouting, drawing the fire of forts to discover their strength, cable-cutting, troop, coal, and water-carrying. All this work can be done by any vessels of high speed and large coal endurance, but it is worth discussing whether, having employed vessels valued at £100,000 to £500,000 each to do this work, it is not desirable to go a little further and make them able to do more by arming and protecting them so that they can meet second-class cruisers with the chances in their favor, and with a fair chance of holding their own against a first-class cruiser. If they can, then the number of cruisers which will be available to protect our commercial routes may be much increased, and we shall not be taking up merchant ships because their speed will enable them to successfully run away from the cruisers of an enemy who are destroying their slower sisters.

The practicability of designing merchant steamers so as to be readily adapted for war purposes has been discussed in the Institution of Naval Architects. The desirability is always a subject for discussion.

The experience of recent wars points to the desirability of having vessels which can carry large coal and store cargoes, and which have facilities for readily transferring these cargoes to warships at sea. This work could be well done by some of the large freight carriers of lines which carry mails. Special appliances would have to be fitted to these vessels, which might or might not carry these appliances in their regular work. In the construction of these vessels special consideration might be given to their use for such purposes. Some large freight carriers have ocean speeds of 15 knots, and such vessels would be of great service in time of war.

A question arises in connection with the special and ordinary types of merchant vessels as to their strength to carry guns. These vessels are generally constructed of scantlings much thicker than those of warships, and many places in their decks are amply strong enough to carry guns. Possibly some parts would require special strengthening, but this could be readily applied if necessary.

In the matter of position of machinery in relation to the water-line, the later vessels of moderate and large size have their machinery and boilers not far, if anything, above the water-line. With a little consideration to the question in the early stages of design and construction it is easy to arrange the structure so that the coal which these vessels carry will give protection. Twin-screw engines and increased revolutions are tending to make merchant ships more safe in this respect.

The principal point to note in connection with merchant ships for war purposes is, that a ship of any kind offers considerable resistance to the destruction of its buoyancy and stability, and, in consequence, with guns and gunners sufficient and sufficiently protected, the merchant ship need not be much, if any, inferior to many warships.—*Engineering.*

THE NEW BRITISH BATTLESHIP VENGEANCE.

H. M. S. Vengeance, to be launched on Tuesday by Messrs. Vickers, Sons, and Maxim, Limited, Barrow-in-Furness, is a first-class battleship laid down on August 23, 1897, and to complete next spring at a cost of £870,419, according to the Navy Estimates. There is no doubt about this time result being realized, as the vessel is much further advanced than is usually the case with vessels to be launched into the water on ways. She is 390 feet long between perpendiculars, 74 feet beam, and some concessions have been made in her design to insure a draught of only 26 feet when she is in full working order. The displacement then will be 12,950 tons, of which 8550 tons are due to the hull. She may be said to belong to the Canopus class, although having been ordered a year later, she embodies several changes in detail. Like the five vessels of the type named, her side armor is of 6-inch thickness instead of 9-inch; but, the face being specially hardened, the shot-resisting power will be greater than that nominally corresponding to the thickness. The broadside armor is 14 feet deep, being carried 5 feet below the load-water line. The length is about 196 feet, leaving about 100 feet forward and aft, but this is more nominal than real, for instead of the thwartship bulkhead being, as has hitherto been general, at right angles to the line of the ship, the end armor is arranged in the form of a >, the point being towards bow and stern, and as this is from 12 inches to 8 inches thick, thinning towards the bottom, it extends the armor protection. Again, the side armor is carried to the ram as 2-inch nickel-steel plating, which broadens as it extends forward till it reaches from top to bottom, and thus the ram is greatly reinforced. Here it may be said also that the forefoot is greatly cut away, as is also the deadwood aft to improve the circle turning of the ship. Abaft the citadel the side plating is made thicker at the load line for a depth of quite 10 feet. The protective deck is 2 inches thick, and as usual, is curved from the bottom of the side armor to above the water-line in the center. This curve enables the engines to be entirely below the deck, obviating the necessity for an armored coaming round the cylinders. There is the usual bunker protection, and coal is carried both under and upon the protective deck, the other levels within the length of the citadel being middle, main, upper, and boat decks. The last-named, however, does not extend the full width of the ship. At the end of the ship there is a platform below the protective deck.

The barbettes for the pairs of 12-inch guns are immediately within the > at the forward and after end of the citadel. These are 36 feet 8 inches in diameter, of 12-inch Harveyed nickel steel. There are four casemates on the main deck on each broadside, there being twelve 6-inch quick-firing guns in all, four of them being placed on the upper deck. The bow and stern quick-firing guns have a range to 28 degrees abaft or forward respectively, and the broadside guns the usual 120 degrees. The casemates are in plan very irregular octagons, the end ones being almost triangular. There are, in addition, eighteen smaller guns, three 12-pounders in the citadel on each broadside on the upper deck, and four on the main deck, two firing forward and two aft. The machine guns are on the bridges and military tops. The masts are very lofty, and carry searchlights, which are placed on a platform well raised. There are two navigating bridges, one forward and one aft, and two conning towers, the forward one having 12-inch Harveyed nickel steel, and the after 3-inch nickel steel. The voice tube and ammunition hoists are armored.

The Vengeance is, of course, propelled by twin screws, each driven by an independent set of triple-expansion engines, with three vertical cylinders of the collective power of 6750 indicated horse-power, the aggregate being 13,500. This is attained with the engines making 108 revolutions, and with a steam boiler pressure of 300 pounds per square inch, reduced to 250 at the engines, and at this point it may be said that the total weight of the machinery, main and auxiliary, including boilers and the water in them, is about 1290 tons. The high-pressure cylinder is 30 inches in diameter, the intermediate-pressure 49 inches, and the low-pressure 80 inches, the stroke being 51 inches. The cylinders are separate and independent castings, stayed together, and all the barrels are jacketed. The high-pressure and intermediate-pressure cylinders are each fitted with one valve of the piston type, and the low-pressure cylinder with the ordinary flat valve fitted with equilibrium rings. The valve gear is the double eccentric ordinary link motion. The straps are separate from the rods, and of forged steel, lined with white metal. Double-cylinder reversing engines are fitted, which in 30 revolutions turn the main engines from full gear ahead to full gear astern. The starting position, it may be added, is amidships.

The bottom frames of the engine are of cast steel, and are bolted together to form one complete bed-plate for each set of engines. Bolts, and not studs, are used for securing the main bearing caps. The front columns are forged steel, and the back columns are of cast iron with guides bolted to them.

The pistons are of cast steel of conical form, the piston-rods of solid wrought steel 8¼ inches in diameter, with a substantial collar under the piston. Ample surface is provided for the ahead and astern guides. The connecting-rods are 8 feet 6 inches long, center to center. The crank and propeller shafts are of forged steel, finished complete at the company's works at Sheffield. The couplings are forged solid with the shaft, except the wrought-iron disconnecting coupling. The total length of the shaft from the main engine to the propellers is about 124 feet. The crankshaft is made in three interchangeable parts, the external diameter being 16½ inches, with a 9-inch hole. The length of the main bearings is 9 feet 6 inches. The crank-pins are 18 inches in diameter outside and 9½ inches inside, and 20 inches long. The cranks are set at an angle of 120 degrees. The sequence is high pressure, low pressure and intermediate pressure, the high-pressure cylinder being placed at the forward end and the low-pressure aft. The propeller shafting between the crankshaft and the stern tube is 15½ inches outside and 8¾ inches inside diameter. The stern shaft for the stern tubes is 16½ inches outside, exclusive of the gun-metal casing, and 9 inches inside. The shafting beyond the stern tube is 17½ inches outside and 10 inches inside. The after coupling of the propeller shafting is so arranged that the after length of shafting can be withdrawn in a forward direction without disturbing the stern-tube shaft. The shafting within the tube is effectively cased with gun-metal. The thrust-block consists of horseshoe collars faced with white metal having a thrust surface of 1800 square inches for each set of engines. The stern tubes are of gun-metal, cast in one length, fitted with lignum vitæ bearings in the usual Admiralty manner. The propellers are four-bladed, of bronze, and 17 feet in diameter, and work inwards. The turning engines with two cylinders are capable of turning the main engines completely round in eight minutes with two-thirds the working pressure of the boilers, and when exhausting into the atmosphere. Hand-turning gear is also provided.

The condensers are circular, made of rolled naval brass plates with gun-metal mountings. One main and one auxiliary condenser are placed in each engine-room. The total cooling surface of the two main condensers is 14,500 square feet, and of the auxiliary condensers 2200 square feet. These latter are used for condensing the steam from the auxiliary engines throughout the ship, and are fitted with a combined circulating and air pump. The condenser tubes are of solid-drawn brass, untinned, ⅝ inch in external diameter and .048 inch thick. The pitch of the tubes is $\frac{31}{32}$ inch. One main air pump is fitted to each main engine, 30 inches in diameter by 19 inches stroke, and is driven by means of levers from the low-pressure cylinder crosshead. These pumps deliver into a hotwell. Two circulating-pump engines are fitted to each engine-room. They are of the centrifugal type, having impellers 45 inches in diameter, driven by a compound engine. The duty expected of these pumps is 1200 tons of water from the bilge per hour with two-thirds the steam pressure, and exhausting into the atmosphere. Either of the two sets in each engine-room is large enough for the duty. The circulating sea-suction pipes are 17 inches in diameter and the discharge 19 inches. These engines are placed as high practicable in the engine-rooms. The hotwell is of 100 cubic feet capacity and is fitted low down in each engine-room. The main air pumps deliver into these hotwells. A pumping engine of the duplex type is fitted to draw from these hotwells and discharge through grease extractor tanks into the feed tanks. These pumps are also connected to the main condensers. Each grease extractor has over 10,500 square inches effective filtering surface, and the extractors are easily cleaned. Tanks for feed water of about 70 tons capacity are provided in wings and double bottoms. These tanks can be filled by means of injectors at the rate of 50 tons per hour. Means are provided for the admixture of lime with the feed water. The feed pumps (by Messrs. Weir), six in number, are fitted in the boiler-rooms; one in each compartment is arranged as a main and one as an auxiliary feed pump. They are of such a capacity that three are sufficient for the full power. The pressure in the feed pipes arranged for is 700 pounds per square inch.

The main steam pipes are of steel, lap-welded with butt-strap over the weld for pipes down to, but not including, 6 inches. Below this they are solid-drawn steel down to 1½ inches in diameter; below this again they are of solid-drawn copper. Reducing valves are fitted in the main steam pipe in each engine-room between the main shut-off valve and the regulating valve. Separators are fitted in the engine-room, one each side, on the boiler side of self-closing valves.

There are twenty boilers of the Belleville type, with economizers, and all recent improvements. Each boiler can be used independently of the others, and works at 300 pounds per square inch. The boilers are arranged in three compartments, eight in each of the forward and middle boiler-rooms, and four in the after. There is no middle-line bulkhead in the boiler-rooms. Fifteen of the boilers have nine elements of large tubes 4½ inches in external diameter, and five boilers consist of eight elements of large tubes 4½ inches in external diameter, each element containing seven pairs of tubes. All the boilers are fitted with economizers, those in the wings of the ship having six elements, and the remainder seven elements in each case. The economizer elements consist of ten pairs of tubes 2¾ inches in external diameter. The heating surface is 21,760 square feet in the main tubes, and 12,010 square feet in the economizers, the total being 33,770 square feet. The boiler tubes are all of British manufacture, as also the material from which they are drawn. The tubes are all solid-drawn, finished cold, carefully annealed after manufacture, and subjected to severe tests. Each tube is coated externally with zinc by electro-deposition at the Barrow Works.

As to the auxiliary engines in the ship, some brief reference may be made. The distilling machinery, by Messrs. Weir, consists of two evaporators capable of evaporating from sea water 68 tons per 24 hours when worked not compound, and 42 tons when worked compound. The two distillers produce 40 tons of fresh aërated water per day, for drinking, at 15 deg. Fahr. above that of the circulating water, with circulating water at not less than 75 deg. Fahr. The electric-light machinery consists of three sets of combined engines and dynamos, the electromotive force being 80 volts for all loads from 10 up to 600 ampères.—*Engineering.*

The commerce-destroyer Jeanne d'Arc, launched on Thursday, June 8th, is in some ways the most important vessel ever constructed for the French Navy. This importance is not confined to the ship itself; it represents a new *motif*, and a *motif* specially considered in connection with this country. At the time that she was laid down the references in some French newspapers to Joan of Arc, and the ignominious defeats that the Maid of Orleans inflicted upon the English, were not called forth merely by the name. Jeanne d'Arc is no new name in the French Navy List. What a good many sanguine Frenchmen look for, or did look for, was that the Jeanne d'Arc would form a type of vessel before which *perfide* Albion would have to go down. In other words, the Jeanne d'Arc is the pioneer of a type intended not merely to be able to destroy our commerce—which a Guichen or Château-Renault could do equally well—but to be able to chase from the seas our Powerfuls and Diadems. Too swift to be caught by battleships, the dream embodied in the Jeanne d'Arc seemed sufficiently real and possible to our Admiralty to lead to the laying down of a good many Cressys and "mighty cruisers." Certainly, on paper, the Jeanne d'Arc looks infinitely better all round than our Powerfuls and Diadems.

The following are the "fighting qualities" of the three types. Many of our readers must by now be familiar with the "War Game" notations of guns and armor, which we have before now utilized for rapid comparisons. We introduce them here:

——	Terrible.	Jeanne d'Arc.	Diadem.
Tonnage	14,200	11,270	11,000
Complement	894	626	677
Guns 1°	two 9.2-inch (B)	two 194 mm. 7.6-inch (C)	nil
Q. F. 2°	twelve 6-inch (D) sixteen 3-inch (12-pounders)	fourteen 5.5-in. (D)	sixteen 6-in. (D) twelve 3-in. (F) (12-pounders)
Q. F. 3°	twelve 3-pounders	sixteen 3-pndrs. eight 1-pndr.	twelve 3-pndrs.
Armor:			
On 1° guns	6-inch (C)	6-inch (C)	——
On 2° guns	6-inch (*c*)	6-inch (C)	4½-inch (*c d*)
Water-line	nil	6-inch (*c*)	nil
Lower-deck	nil	3-inch (Σ)	nil
Slopes of armor deck in inches, 6 inches equivalent to a protection of	= *a a*	3-inch (*c*)	= *b*
Protection to vitals	= *a a*	= *a a*	= *b*
H. P. (maximum)	25,000	28,500 (estimated)	18,000
Speed (maximum), knots	22	23 (estimated)	20.8
Screws	2	3	2
Coal (normal), tons	1,500	1,400+petroleum	1,000
Bunker capacity, tons	3,000	2,000+petroleum	2,000

Now from this it is evident that the armored water-line and extra speed are the Jeanne d'Arc's *pro's*, while the lack of 3-inch guns makes her armament completely inferior. Before, however, proceeding to carry the comparison further, we will give further details of the French cruiser.

The water-line belt is complete. Probably it will, like French belts generally, be completely under water; indeed, by design it is practically that. Above it, however, the lower deck is protected by 3-inch armor of a resisting value equivalent to the coal bunkers on the Powerful's lower deck. Probably there are bunkers behind that might be full; but as the ship will carry only 1400 tons normally, while the Powerful normally stows nearer 3000 than her nominal 2000, the Powerful has a superior coal protection. Now the 3-inch armor of the Jeanne d'Arc is not thick enough to keep out our 6-inch Lyddite shell, consequently, save for hits at a wide angle, is of little more utility than the unarmored side of the Powerful, and trusting, as this ship does, to her coal bunkers, it is not impossible that her water-line will prove in practice quite as safe as the Jeanne d'Arc's.

The protective deck of the Powerful being thicker, it will be noted that her vitals are as safe as those of the Jeanne d'Arc. So, so far as the Jeanne d'Arc is concerned, are those of the Diadem; the 8-inch guns could never penetrate the Diadem's deck, except possibly at the muzzle. The weak point in the Diadem and the Powerful, the ability of 3-inch guns to destroy their water-lines, the Jeanne d'Arc is not provided to cope with. The entire bow of the Jeanne d'Arc is covered with 3-inch armor, some protection to the base of the forward 7.6-inch guns, but again too thin to keep out shell, except at very long range and at an acute angle. She would have to fight at long range to avail herself of it, and then the absolutely unprotected bases of her 6-inch guns would give trouble. The Powerful has casemates or bunkers under her 6-inch guns, and being a heavier ship with less armor to carry, she is presumably of stouter construction to withstand shell under the guns.

As originally designed, it was intended to give the Jeanne d'Arc eight instead of fourteen 5.5-inch guns (13.8-centimeter) and twelve 3.9-inch guns. These twelve would have been carried where the six upper-deck 5.5-inch pieces now are, that is to say, eight in caves about the forward group of funnels, and four aft in gun-houses of a kind. It was concluded that these 3.9-inch pieces would be of little use, so every other one was knocked out and 5.5-inch guns substituted. This had the additional advantage of simplifying the armament, an important thing, seeing that how to supply the guns has been a tremendous problem, even with the simpler armament.

The fact is that the 23 knots of the Jeanne d'Arc have to be paid for, and paid for heavily. The whole of the ship between the masts is occupied with engines and boilers. The French take some pride in themselves over the ingenious way in which, despite the huge space taken by the engines, they have been able to work in magazines below them, and run the ammunition hoists up through boiler-room and machinery. It is a triumph—of a sort; but though ammunition hoists passing close to furnaces, and kept at a temperature of 40° or 50° by means of refrigerators inside them may be exceedingly ingenious, and may work all right, their existence is not likely to assist the engine-room department in maintaining that coolness of temperament which will be necessary to ensure the 23 knots.

Taking her all in all, the Jeanne d'Arc is an ingenious vessel—too ingenious. Despite all that has been written by partially-informed critics, we feel certain that in war-time she would be no match for the Powerful; and in action with the splendidly simple Diadem would by no means be a certain winner. Personally we should feel happier in the Diadem. In energy of fire, on paper, the Jeanne d'Arc has, we know, a better broadside, while her end-on fire, again mightily ingenious, is ten 5.5-inch and one 7.6-inch, against six 6-inch, on paper. On the beam or quarter there are positions in which she could bring four, or even six, 5.5-inch guns and one 7.6-inch against the Diadem's three, or say four 6-inch. But the difficulties of securing such a position, and the still greater one of maintaining it, practically put it out of court. Her armored area throws that of the Diadem into complete insignificance. But, as we have shown, the value of her armor is very slight, and it stands to reason that on the same displacement of the Diadem a cruiser cannot have all this armor and extra H. P. without heavy sacrifices elsewhere. Battles are fought at sea, not on paper.

We would not go quite so far as to characterize the Jeanne d'Arc as a "fraud," but she is not far from it, and certainly will never sweep our cruisers from the sea. We have purposely compared her to the Powerful and Diadem rather than the new cruisers, because those are the ships she was designed to compete with. As to our new cruisers, the Cressys and Drakes, there is no comparison possible. These are practically Powerfuls with sides armored better than those of the Jeanne d'Arc, and —important point—with the bases of the gun positions unassailable by shell. As to speed, the Jeanne d'Arc's 23 knots mean nothing as yet. No "maximum speed" could be kept up at sea, if even it could be reached. The question is, What is the highest constant speed she will be capable of, and for how many hours? Modern French battleships are swifter than those we have in commission, but their coal will not allow of more than a comparatively few hours' steaming at it; hence much of its value is lost. Carrying liquid fuel in addition to her 1400 tons of coal, the Jeanne d'Arc may be better off than many ships in this respect, but this question cannot be profitably discussed till she has been on trials, and we are not sufficiently acquainted with her lines to know whether, like British cruisers, she can fill her bunkers to the maximum capacity and yet lose next to no speed in consequence.

To return to the discussion of the Jeanne d'Arc's details. She is 477 feet long, 63⅔ feet broad, and will draw 26½ feet of water. The engines will be three sets of vertical triple-expansion, each set actuating a screw. Steam will be supplied by forty-eight Du Temple boilers, as at present decided, but possibly some other boiler may be substituted; there is very strong agitation in France in favor of the Niclausse.

The form of funnels, or rather, forms adopted for the Jeanne d'Arc, is worthy of remark. The casing of the after group is to be kept low "in order to assist stability." Here, again, is an exhibition of ingenuity that, had the ship been one of ours, we should not regard the need of—if it is a case of necessity, or anything approaching necessity—with particularly pleasant feelings. There seems too much "wonderful balancing feat" about it.

The Jeanne d'Arc, in fine, is likely to prove a Great Eastern—more wonderful than useful.

It is a French custom to give various decorations after the launch of a ship of war. After the launch of the Jeanne d'Arc one officer decoration and three chevalier decorations of the Legion of Honor, and five *médailles militaires* were conferred on those concerned.—*Royal United Service Institution.*

In the English naval manœuvres the torpedo-boat destroyer flotilla will consist of the 24 torpedo-boat destroyers, forming the instructional flotillas attached to the various home ports, with the four destroyers, specially commissioned; they are to have a week's preliminary training in evolutions under the command of Captain Durnford of the Vernon torpedo-school at Portsmouth, who will hoist his commodore's pennant on the torpedo-gunboat Jaseur. The torpedo-boat flotilla will have assembled at Plymouth and are to rendezvous at Belfast on the 22d inst., where they will join the squadron under the command of Vice-Admiral Sir H. Rawson. As usual, the port-guard and first reserve ships have been brought up to their sea-strength, the latter with the Howe and Thunderer, being completed by coast-guard men.

By Admiralty order only signalmen who have had seagoing experience have been sent to torpedo-gunboats, torpedo-boat destroyers, and torpedo-boats for the manœuvres, and at least two-thirds of the engine-room ratings of torpedo-boat destroyers specially commissioned for the manœuvres were to consist of men who have undergone instruction in these boats. If necessary, supernumeraries (with the exception of the Royal Naval Reserve men borne for training) were to be discharged from the Channel Squadron ships to make up to seagoing strength the complements of specially commissioned ships. The Juno has been specially fitted for experimenting with Marconi's system of wireless telegraphy.

It is stated that during the manœuvres experiments with carrier pigeons will be tried on a much more extensive scale than has hitherto been attempted in the British Navy. The birds have all been trained under expert supervision, and will have their headquarters on one of the torpedo-gunboats, which is to be specially commissioned, and will be under the charge of an experienced naval officer.

The Manœuvres.—The Admiralty have officially defined the object of the naval manœuvres this year to be as follows:

1. The principal object of the 1899 manœuvres is to obtain information as to the most advantageous method of employing a considerable body of cruisers in conjunction with a fleet.
2. The subsidiary object is to throw some light on the relative advantages and disadvantages of speed and fighting strength.
3. Another subsidiary object is to obtain information relative to the working of destroyers and torpedo-boats.—*Royal United Service Institution.*

LORD BRASSEY ON THE BRITISH NAVY.

The address delivered by Lord Brassey, the Governor of Victoria, to the Melbourne Chamber of Commerce, is an exhaustive summary of the present condition of the British Navy.

The estimates of the current year amounted for the French Navy in round figures to $62,500,000; for the Russian, to $43,500,000, and for the British to $132,970,000, which last was an increase of $15,000,000 on the previous year. The shipbuilding vote alone reached the enormous figure of $64,085,000, an increase upon last year of $10,080,000. It is the announced policy of Great Britain to make her navy equal in strength to the navies of any other two powers combined, and certainly she does so this year, in new construction, with a liberal margin. She builds more cheaply, too, than France and Russia.

But Lord Brassey holds that the British Empire can afford this naval increase. He quotes Sir Robert Giffen to show that the Empire's combined revenues are $1,490,000,000, an increase of $575,715,000 since 1871, or more than 40 per cent. of the present total. Its exports and imports aggregate $6,875,000,000, an increase since 1871 of $2,140,000,000, or about one-third of the present total. On the other hand the national debt, which was $3,845,000,000 in 1875, had been reduced last year to $3,375,000,000, while private wealth has increased. In contrast we have a great increase of the Russian debt in the last twelve years.

While France has a permanent naval force of 42,000 men, and Russia one of 35,000, the proposed British strength for the current year is 110,640, showing an increase of 4250. No fewer than 27,000 men have been added in the last five years. But Lord Brassey shows anxiety over getting men for the reserve, and says that the resources for recruiting from blue-water seamen are diminishing. Steam and the Suez Canal have brought up the foreigners to 40 per cent. of the total crews of British ships.

At the end of this year England will have forty-six battleships completed of the first and second class, the oldest scarcely ten years in commission; while France has thirty-three, and Russia eighteen. Of the British ships twenty-three will be of the first class, as against eighteen of the other two powers. And in average size the British ships are especially superior. Under construction England has sixteen battleships, "more than any three other powers combined." The latest ships, those of the Canopus and Duncan types, displace 14,000 tons, or about 1000 less than the Majestic and Irresistible. The biggest ships gain in sea-keeping qualities, steadiness of gun platform, armament, protection and coal endurance, but their deep draught keeps them out of many good harbors. In view of what is claimed for the French coast defenders, with two heavy guns in single turrets, and with light draught and facility in turning, Lord Brassey thinks the British answer to these should consist in part of ships especially adapted to narrow waters, where protection and number of rams and guns are more important than steadiness of platform in heavy seas, or than coal endurance. In general he notes the modern tendency to carry armor over a large area of side, even at the cost of thinning it at the water-line. The twelve British battleships of the third class far exceed in tonnage and sea-keeping qualities the twelve on the French list, and there are many that can be re-armed and brought up to date.

In cruisers Great Britain seems comparatively stronger than in battleships; for she has completed 119, against 32 for France, 13 for Russia, 17 for Italy, and 20 for Germany. Limiting the comparison to first-class cruisers launched since 1886, or now building, Great Britain has 40, aggregating 413,500 tons, against 13 of 109,375 tons for France, and 11 of 96,713 tons for Russia. In the British list are eight of the Terrible class, 14,000 tons and 21 knots; eight of the Cressy, 12,000 tons and 21 knots, and eight of the Diadem and Spartiate classes, 11,000 tons and 20 knots. England's really imposing list, however, is that of her latest line-of-battle ships, which include eight of the Royal Sovereign type, 14,150 tons; nine of the Magnificent, 14,900; six of the Formidable, 15,000 tons; six of the Duncan, 14,000; the Renown, 12,350, and six improvements on her of the Canopus type, 12,950; six of the Admiral type, 10,300, and five more of a displacement somewhere between the Admirals and the Royal Sovereign.

Lord Brassey does not forget the value of England's enormous mercantile marine as an auxiliary for offense and defense. It includes over 70 per cent. of the world's steamers. In 1898 England built no less than 1,367,000 tons, nearly all steamers, and at a recent date had in hand as much more mercantile shipping, besides the warship construction. Of course, this may in one sense be called a source of weakness as well as of strength, because it requires protection in war, but Lord Brassey is confident that a successful system of convoy can be established for it.

PRESENT EFFECTIVE STRENGTH.

	Britain.	France.	Russia.
Battleships—			
First Class	18	8	4
Second Class	11	9	10
Third Class	12	15	1
Total Battleships	41	32	15
Cruisers—			
First Class	21	3	4
Second Class	57	21	7
Third Class	41	11	2
Total Cruisers	119	35	13
Total Battleships and Cruisers	160	67	28

It will be seen from the table that England has a marked total preponderance over the other two powers. With regard to the future her position is still more satisfactory. He has prepared a table showing the probable strength of completed ships at the end of 1899, which is as follows:

ESTIMATED STRENGTH AT END OF 1899.

	Britain.	France.	Russia.
Battleships—			
First Class	23	9	6
Second Class	11	9	9
Third Class	12	15	3
Total Battleships	46	33	18
Cruisers—			
First Class	25	7	7
Second Class	60	23	7
Third Class	42	12	4
Total Cruisers	127	42	18
Total Battleships and Cruisers	173	75	36

—*New York Sun.*

LIQUID FUEL.

The advantages of liquid fuel are well known, and have been repeatedly stated, the best presentation of the subject being Colonel Soliani's article before the Engineering Congress at Chicago in 1893. From the Italian experiments there described one very important fact is deducible which is worth noting, as it corrects a very common, but mistaken, notion, namely, that the use of steam for atomizing the oil is inadmissible on account of the large amount that would be required. In these experiments it was found repeatedly that the steam used for atomizing was less than 2 per cent. of the amount vaporized.

Inasmuch as the evaporative power of fuel oil is from 1.5 to 1.7 times that of coal, a simple calculation will show that, in one of our first-class torpedo-boats, if enough space be reserved for fresh water to make up for the steam used in atomizing, the amount of fuel oil that can be carried in the present bunker capacity will more than equal the evaporative effect of the total amount of coal now carried. This is important, because the steam atomizers involve very little complication, while the use of compressed air involves a good deal.

Another point in connection with the use of fuel oil which should be carefully noticed is that many people conclude, because fuel oil has a greater calorific value than coal, that a boiler worked with liquid fuel will necessarily have a greater power than one worked with coal. This inference is not only not justifiable, but is probably erroneous. The experiments thus far made with liquid fuel under high forcing have shown a rate of combustion equivalent to only about 55 pounds of coal per square foot of grate, while there are reliable data of coal having been burned at the rate of more than 80 pounds per square foot of grate. There are practical difficulties in the way of providing an adequate supply of air for burning the fuel oil in large quantities under a given boiler that make it seem probable that, where the very highest results must be obtained, coal will be used.

The cost and difficulty of obtaining fuel oil in all parts of the world have thus far prevented its general use, and, as far as can be seen now, seem likely to continue to that effect.

TRIAL TRIPS.

The new first-class cruiser Guichen, one of the two commerce-destroyers so-called, has been continuing her trials at Toulon, but up to the present with unsatisfactory results; she is supposed to have a speed of 24 knots, but it has only been possible as yet to get 22 knots out of her, and that with difficulty; it has now been decided to reduce the diameter of the propellers, increase the revolutions, and also to alter the disposition of the weights on board. The general results of the trials of this ship have been so disappointing that, as far as possible, all the details are being kept dark.

The new torpedo-boat destroyer Durandal has been carrying out her trials at Cherbourg successfully, having maintained a mean speed of 27.4 knots with [illegible] revolutions, or a knot over the speed required by the contract. The Yacht claims for the Durandal class that, although nominally they have a less speed than the English destroyers, yet that they are stronger built, are better sea-boats, and consequently can maintain a high speed under circumstances when the English destroyers would be unable to do so. This, however, has yet to be proved, as there is no very great difference in the relative dimensions of the French and English vessels. The English 30-knot destroyers vary in length from 210 feet to [illegible] feet [illegible] inches, and in beam from [illegible] feet [illegible] inches to 22 feet, with displacements varying from [illegible] to [illegible] tons. The Durandal is 180 feet 5 inches long with a beam of [illegible] feet [illegible] inches and a displacement of 300 tons, while the four latest destroyers of the Framée type are slightly larger, viz., [illegible] feet [illegible] inches long with a beam of [illegible] feet [illegible] inches and a displacement of [illegible] tons.

NEW SHIPS.

The contract for the construction of the first-class armored cruiser Sully, one of the modified Montcalm type, has been signed with the Forges et Chantiers de la Méditerranée at La Seyne near Toulon by the Minister of Marine. Her dimensions are to be as follows: Length, 448 feet 6 inches; beam, 65 feet 6 inches; with a mean draught of 22 feet 9 inches on a displacement of 10,000 tons. The armament will consist of two 19.4-centimeter (7.6-inch) guns in turrets, one forward and one aft; eight 16.4-centimeter (6.3-inch) Q. F. guns, four in small turrets and four in armored casemates; six 10-centimeter (3.9-inch) Q. F. guns on the spar deck, which is two more than in the Montcalm class; there will also be eighteen 3-pounder and six 1-pounder Q. F. guns, with two submerged torpedo-tubes. The Sully will have a 6-inch belt of Harveyized steel, tapering to 3 inches towards the extremities, while the guns will also be protected by 6-inch armor, except the 3.9-inch guns, which will have 2-inch shields. There will be three screws, and under forced draught the speed will be 21 knots, while the mixed coal and petroleum fuel will give her at 10-knot speed a range of action of 10,000 miles.

The oil-fuel trials in the torpedo-boat destroyer Surly have virtually been abandoned, it having now been demonstrated that unless special arrangements are made for consuming the smoke the adoption of oil as a fuel is impracticable. When the experiments commenced, about a year ago, great expectations were formed, as it was believed that the liquid fuel would be cleaner, cheaper, and so far automatic in its feed as to save a considerable amount of labor in the stokehold. Throughout the whole of the trials, however, the Surly only once went to sea, and then it was found that owing to the low evaporative qualities of the oil the speed and power were far inferior to what would have been produced by coal. But it was hoped that by improved appliances to so obviate the escape of heat that this difficulty would be overcome, while the absorbing problem was the question of smoke abatement; and to this no solution has been found. Had the authorities been resolved to create the maximum of smoke with the minimum of steam they could not have succeeded better; but this was the exact opposite of what they were striving for. Nor was this one of those experiments that are foredoomed to failure, because the order was given that every mechanical contrivance was to be exhaustively tested until success was assured; but from first to last there was no diminution in the density, the dirtiness, or the nauseous smell of the smoke. Our contemporary the *Naval and Military Record* finds comfort in the failure of liquid fuel, not merely because the adaptation of existing machinery to the new conditions would be expensive and tedious, but because it would be necessary to maintain reserves of oil at all the coaling stations, thus involving risks that are anything but desirable.—*Engineer.*

The six torpedo-boat destroyers laid down at the end of last year are to be called the Dardo, Strale, Nembo, Turbine, Aquilone and Borea. They will have a displacement of 250 tons and a speed of 30 knots. The new torpedo-boat Condore attained a speed of 19 knots under natural and 21.2 knots under forced draught.—*Royal United Service Institution.*

U. S. TORPEDO-BOAT DESTROYER STRINGHAM.

The U. S. S. Stringham, the first torpedo-boat destroyer completed on the Atlantic coast, was put into the water at Harlan & Hollingsworth's yard, Wilmington, Del., on Saturday, June 10. The launch was particularly successful and though it took place in a drizzling rain the enthusiasm of the hundreds gathered about the ship was not dampened, for the boat took the water to the accompaniment of hearty cheers and well wishes. She was christened with the customary bottle of wine by Miss Edwina Stringham Creighton, of Morristown, N. J., a granddaughter of the late Admiral Silas H. Stringham.

In our issue of February last a description of this vessel was given with drawings of the engines and hull. Her construction was authorized by Congress in the act approved March 3, 1897, and the contract for her construction was signed with the Harlan & Hollingsworth Co., of Wilmington, Del., July 29, 1897. The keel was laid March 21, 1898, and the contract date of completion was set at July 29, 1899. The price for hull and machinery, exclusive of ordnance and outfit, is $236,000. She is 225 feet long, 22 feet extreme breadth, and at 6 feet 6 inches mean draught displaces 340 tons. The design in its general features follows the English type of boat, but it is not a close copy of foreign plans. She has four Thornycroft water-tube boilers, and three stacks, the two middle boilers having a common stack. The engines are twin screw, vertical inverted, triple expansion, designed to indicate 7200 horse-power, which is expected to drive the boat at least at the guaranteed rate of speed of 30 knots. Her allowance of coal at the normal draught of water is 35 tons, and her bunkers will stow 120 tons. She carries an unusually heavy battery for boats of her class, as in addition to two deck discharging tubes for 18-inch Whitehead torpedoes, she mounts seven 6-pounder R. F. guns, one on top of each of the two conning towers, and the other five on the deck between the conning towers. The officers' quarters aft consist of a cabin and state-room for the captain, a state-room each for the executive officer and engineer, and a mess-room, abaft which is a pantry and bath-room. Forward of the captain's quarters is a compartment with four berths for petty officers, and one with six berths for machinists. Forward of these is the firemen's quarters with twelve berths. Forward of the firemen's quarters is the engine room, occupying the full width of the boat for 28 feet, and then come the boiler compartments and coal bunkers, which absorb 73 feet of the length of the boat. Forward of the boilers is the galley and then the crew's quarters, with twenty folding berths, and in the extreme bow the windlass compartment. A turtle-back is built from the forward conning tower to the stern, and the latter has a sharp rake instead of being plumb as usual.

The boat was launched with the machinery in position and will soon be sent on her preliminary trial. She is one of the three destroyers contracted for in July, 1897. The other boats of this trio are the Bailey, under construction at Morris Heights, N. Y., and the Goldsborough, building at Portland, Ore. They are of smaller dimensions.—*Marine Engineering.*

TORPEDO-BOAT DESTROYER FARRAGUT—FASTEST VESSEL IN THE NAVY.

U. S. S. Farragut, the first American torpedo-boat destroyer, is now complete, equipped and ready for sea. This fine boat, which is the fastest in our navy, was recently tried and accepted by the Government on the Pacific Coast, she having been built by the Union Iron Works. The contract for this boat was signed October 5th, 1896, and the keel of the vessel was laid July 26th, 1897. She was launched July 16th, 1898, and delivered to the Government December 31st last. Her dimensions are: Length, 214 feet over all; beam, 20 feet; draught, 5 feet 7 inches; and trial displacement, 240 tons.

She is fitted with twin-screw engines of the four-cylinder, four-crank, triple-expansion type, with cylinders 20 inches, 29 inches and two 30 inches diameter and 18 inches stroke. The air pumps are driven direct from the crank shafts by an extension at the forward end of each. The engines are of course designed with a view to getting the maximum power on the minimum weight. Hollow forgings are extensively used, including the crank shafts, each of which is in one piece with the eccentrics forged on. Very complete arrangements for oiling are provided, including centrifugal oilers for the crank pins, and large tubes down the sides of the connecting rods. The main condenser has a copper shell and is placed between the engines with scoops at both ends connected with openings in the bottom, through which the circulating water is forced by the motion of the vessel when steaming. A small circulating pump in the form of a two-bladed propeller is placed in the after scoop to start the circulation when the destroyer is starting out or lying at anchor. The boilers are three in number, of the Thornycroft type, each rated at 2000 horse-power with 240 pounds pressure. The Farragut also carries a distilling plant in the engine-room.

The propellers are three-bladed, of solid bronze, and are carried by forged steel struts far below the keel line, the vessel being cut away tremendously aft for this purpose. They are 6 feet 9 inches in diameter and 8 feet 9 inches pitch, and they turn up 420 revolutions when the boat is going full speed.

In the shape of armament she is fitted with three 6-pound rapid-fire guns, two 18-inch torpedo-tubes. There is a small conning tower forward and another aft. Six torpedoes are carried stowed away forward under the turtle-back.

On trial the Farragut showed an average rate of speed of 30.6 knots. The contract price for the hull and machinery was $227,500.—*Marine Engineering.*

Published designs of the new royal yacht Victoria and Albert for Queen Victoria show an antiquated looking vessel, following very closely in general appearance the present side-wheel vessel of the same name. The new vessel was launched at Pembroke Dock Yard, May 9, by the Duchess of York. She was designed by Sir William White, Chief Constructor of the British Navy, with the view of being used exclusively as a yacht; so that the vessel will not be a combination of warship and pleasure craft, as is the case with yachts of other monarchs. Considered therefore as a yacht pure and simple she is the largest vessel of this type afloat. Her dimensions are: Length, 420 feet; between perpendiculars, 380 feet; beam, 50 feet, and displacement 4700 tons on 18 feet draught of water. It was undoubtedly the wish of her royal owner that the new vessel should be designed so as to closely resemble the present Victoria and Albert, for in other respects the new vessel is strictly up-to-date. She will be fitted with Belleville water-tube boilers, and two sets of four-cylinder, triple-expansion engines of 11,000 collective horse-power, driving twin screws. Her sea speed will be about 17 knots, but she will be capable of spurts of 20 knots. She will be sheathed and coppered, but will carry neither armor nor armament, except possibly a couple of small guns for saluting purposes. She will have high sides with large square ports running her entire length fore and aft; a clipper bow, and overhung stern and two smoke pipes with bellmouth tops.—*Marine Engineering.*

The Seagull, torpedo-gunboat, the only vessel in the navy provided with the Niclausse type of water-tube boiler, carried out a satisfactory eight-hours steam trial at Portsmouth on Tuesday, the 6th inst. The trial of the boiler was begun some months ago, but was abandoned in consequence of the excessive vibration, a defect which has since been remedied by balance weights. The engines were required to develop 2500 indicated horse-power, and the mean of eight hours was 2664 indicated horse-power. The steam in boilers has 150 pounds to the square inch, which was found to be in excess of the amount required to produce 240 revolutions a minute, as stipulated, and which gave the ship the speed of 17½ knots, with a coal consumption of 1.76 pounds per unit of power per hour.—*Engineering.*

The fleet of the German Navy consists of 11 battleships, eight coast ironclads, 13 ironclad gunboats, 10 large and 23 small cruisers, three gunboats, about 100 torpedo-boats, 16 training ships, and 13 ships for special purposes, with a total displacement of 326,701 tons and 399,030 horse-power. There are 16 admirals, 811 naval officers, 40 officers of marines, 128 engineer officers, 142 surgeons, 57 ordnance and artillery officers, 41 torpedo officers and engineers, 104 paymasters, 26 retired officers, 207 midshipmen, 120 cadets, 1058 deck officers, 4740 non-commissioned officers, and 17,597 men.—*Engineering.*

The German shipbuilding industry is making strides corresponding with the general commercial progress of the Empire. In 1898 there were in course of construction for foreign navies 22 battleships, viz., one armored cruiser, three big protected cruisers, 10 torpedo-boat destroyers, and eight torpedo-boats. Of these one torpedo-boat destroyer falls to Brazil, one to Japan, together with eight torpedo-boats and one armored cruiser; the latter at the price of 13,000,000 marks. Italy takes four torpedo-boat destroyers, and Russia four torpedo-boat destroyers and three big cruisers, the latter at a value of 24,000,000 marks.—*Engineering.*

A few days ago the final trials of the Holland submarine boat were held over the course in Peconic Bay. The trials were for the purpose of ascertaining the effect of wave motion upon the vessel while going at a high rate of speed while on the surface, and to see if a high speed could be obtained at any increased power. The vessel showed remarkable ability in making rapid headway in moving backward when the power was increased. The trial was made over a thousand-foot course, and the time was 1:23; a trifle more than 112 horse-power was used. This gave the boat a speed of about ten knots an hour. The new set of dynamos, to be operated by oil, will be installed in the boat to take the place of those now operated by air.—*Scientific American.*

The Holland submarine torpedo-boat has been again tested in Little Peconic Bay. Torpedo trials were made as well as a test for speed and submergence. The torpedo was a dummy of the small Whitehead type and was blown from the tube by air pressure and was taken in a straight line for about 75 feet. There was hardly any disturbance in the water from the discharge of the torpedo, only a few air bubbles showing on the surface near the bow of the boat.—*Scientific American.*

Le Yacht states that four submarine boats of the Narval type are to be built this year at Rochefort, in addition to those building at Havre and Cherbourg. The same paper states that orders have been received at Rochefort to put in hand four torpedo-boat destroyers of the type of the Fauconneau, of which the plans are due to M. Normand. They are to bear the names of Pertuisane, Escopette, Flamberge, and Rapière. Their length will be 56 meters, and their displacement 303 tons. They will each carry one 6.5-centimeter quick-firing gun, six 4.7-centimeter quick-firing guns, and two torpedo-tubes. With 38 tons of coal they are expected to run 2300 miles at 10 knots, or 220 miles at their full speed of 26 knots.—*Scientific American.*

The Dahlgren, in her harbor trial on July 22, developed 29¾ knots. The course was the same over which the torpedo-boat Cushing made her trial trip seven years ago. The trial was under forced draught, with four inches air pressure. The engines made 316 revolutions. Her builders, the Bath Iron Works, have no doubt as to the official trials, which take place in the course of a very few weeks. Her boilers easily maintained a steam pressure of 230 pounds.

The hull of the new torpedo-boat destroyer Bailey, which is being built by the Gas Engine and Power Company, at their works at Morris Heights, is rapidly nearing completion, and it is hoped that the new craft will be launched shortly. The machinery and boilers will not be placed in her until she is launched, and it is expected she will be ready for her speed trial in about a month after launching.—*Scientific American.*

NEW U. S. 30-KNOT TORPEDO BOATS DAHLGREN AND T. A. M. CRAVEN.

The construction of the United States torpedo-boats Nos. 9 and 10, since named Dahlgren and T. A. M. Craven, was authorized by act of Congress passed June 10, 1896, and the contract for these vessels was awarded to the Bath Iron Works, of Bath, Me., on October 6, of the same year. The contract price for the hull and machinery (exclusive of ordnance equipment and outfit) was $194,000 each.

The principal dimensions of these interesting vessels are as follows:

Length over all	151 feet 7 inches.
" on L. W. L.	151 feet 3 inches.
Beam moulded	16 feet 4 inches.
" over guards	16 feet 11 inches.
Depth amidship side	9 feet 4 inches.
" " center	10 feet 0 inches.
Mean draught	4 feet 8 inches.
Draught aft under propellers	8 feet 9 inches.
" " " rudder	6 feet 11 inches.

The Dahlgren and Craven, although designed and built throughout by the Bath Iron Works, are of the Normand type. General T. W. Hyde, the president of the Bath Company, whilst in Europe three years ago, purchased from Mons. A. Normand, of Havre, France, a complete set of plans of the Cyclone, a 145-ton, 29-knot torpedo-boat, then building for the French government, and these plans have guided the Bath yard and have proved of great value in working out problems both in original design and detail work. The guaranteed rate of speed of the Dahlgren and Craven is 30½ knots, this speed to be maintained at sea for one hour. No other shipbuilding firm in the world has as yet guaranteed this enormous speed on such a small displacement as 150 tons, but the builders are confident that these vessels will not only attain the high speed specified in the contract, but will make this speed and carry the required load of 20.29 tons, on a smaller displacement than that specified.

The steel hull of the Dahlgren (now completed) is acknowledged to be the lightest for its size ever constructed, and the machinery is likely to be the lighest per. I. H. P. as yet built in this country. The Dahlgren has a most pronounced hog sheer, with a much higher bow than the Normand boats possess. She has a square forefoot with strong U sections forward. There is a slight drag aft, and the deadwood stops at a point about 15 feet forward of the aft perpendicular, forming the sternpost. Here a large balanced rudder is hung, 6 feet long and about 4 feet 6 inches deep. The midship frames are well rounded; the greatest beam is about 3 feet above the load water-line, and above this point there is a rapid tumble home. The shapes of the midship frames approach very nearly circular sections, thus giving great natural strength, and it is also well to note that the moment of inertia increases as the vessel is heeled; thus giving a higher metacenter when inclined than in the upright position. The water lines aft are very full, and the vessels have the usual Normand knuckle stern which has proved so efficient.

The frames are spaced 20 inches apart, except in the machinery spaces, where they are somewhat closer and located to suit the engines. There are eight watertight bulkheads extending up to the main deck, besides a few non-watertight and the usual wing coal bunker bulkheads. The compartments in the forehold (in the hold forward of the boiler-room bulkhead below the lower deck) are used as chain lockers, and for the stowage of ammunition, torpedo war-heads; water tanks for the reserve feed water and fresh water for domestic purposes are also located here. All the available space in the aft hold is used for the stowage of ammunition. The stern of these vessels is of wrought steel, and the stern-post, rudder frame and shaft brackets, or struts, are of cast steel.

All the steel used in the construction of these vessels is high-grade steel galvanized. The steel before being galvanized had an ultimate tensile strength of 78,000 to 84,000 pounds, with an elongation of 15 to 22 per cent. in 8 inches, and an elastic limit of about 44,000 to 52,000 pounds.

The crew is berthed on the lower deck forward. There are berths for twenty-four men, and the quarters are unusually roomy and comfortable for a racing machine. Just abaft the engine-room bulkheads are two large state-rooms, which together occupy the full width of the ship. The starboard room is for the commanding officer and the port room for the chief engineer. These rooms are complete in all their appointments. Just aft of them is the ward room, 7 feet 6 inches by 16 feet. This room contains the usual mess table, lockers, etc., and two sofa berths. Aft of the ward room is the pantry, the officers' w. c. and the companionway which leads into the aft conning tower. Abaft the officers' quarters and separated from them by a steel watertight bulkhead are the machinists' quarters, 16 feet 6 inches long and the full width of the boat. Here four berths and four sofa berths are located, also the usual folding table, lockers, lavatories, etc. The space aft of the machinists' quarters makes a most desirable general store room.

An aluminum alloy is used extensively on these boats. The galley, aft conning tower, cases for spare torpedoes, engine hatch covers, cowls, and all deck opening covers are made of this material, 7-64 inch thick. The main deck is covered with linoleum 5-32 inch thick, but a light wood grating in wood patterns will probably be fitted over the boilers on this deck.

Torpedo-boats of the Dahlgren class have two short, stumpy-looking smoke pipes. They are only 8 feet 6 inches high above the deck—a few inches above the awnings—and are of elliptical section measuring about 4 feet fore and aft and 3 feet athwartships. The galley, made of aluminum, is located between the stacks. It is only 5 feet long and 4 feet wide, but a galley range, coal box, sink and dresser are contained in it. Abreast the galley is a large ventilator cowl about 3 feet diameter, which delivers air to the horizontal ventilating fan used for forced draught, and which is located in the fire room below.

There are two conning towers. The forward one is made of steel, bullet proof. It is of a peculiar shape, for the forward part contains the steering engine and wheel, the helmsman being below the level of the deck so that the lookout can see over his head. The Hyde steam windlass is located just forward of the conning tower. The steering engine is arranged to work the windlass in an ingenious manner. There is no turtle-back fitted on these boats, but a high breakwater runs diagonally aft from the forward side of the conning tower. The aft conning tower, or observation house, is made of aluminum, and, as before stated, forms the companionway to the officers' quarters. The hand steering wheel is placed in this tower.

The boilers in these boats are the largest Normand boilers, and they project through the deck considerably, thus necessitating large boiler casings. The engine casings have also had to be made quite large, as the Normand engine is a short, wide engine, and the top of the cylinders on these boats come just about on a level with the deck.

The Dahlgren and her sister each carry two 14-foot cedar boats and the usual U. S. Navy equipment for this class of vessels. They are fitted with two deck discharging tubes for 18-inch Whitehead automobile torpedoes, both of which are located in the center line of the vessel abaft the engine room casing, one being at the extreme aft end of the deck. They also carry a battery of four 1-pounder rapid-fire guns, two forward and two aft. Coal bunkers are arranged on each side of the boilers, and between the engine and boilers is an athwartship coal bunker. The total bunker capacity is 32 tons, and at full power the consumption will be about 3 tons of coal per hour. About 7 tons of water will be carried in the tanks forward.

There are three large watertight hatches in the main deck with spring covers, which can be opened from either side, communicating with the engine room. Two more lead to the fire room, one leads to the machinists' quarters, one to the general store room aft, one to the crew's quarters, and two smaller hatches give easy access to the back of the boilers. The crew's space is also entered from the forward conning tower. The crew's w. c. is located on the main deck aft. The vessels are rigged with a hinging 30-foot spar alongside the forward conning tower, which will be used for signaling purposes. A wood fender is worked on the sides of these boats for about three-fourths of their length amidships.

As the propellers project beyond the sides of the boats large pipe propeller guards have been fitted aft, the width over these guards being about 15 feet. The Dahlgren's machinery consists of two vertical triple-expansion engines driving twin screws. They have each three cylinders, the diameter being 17¼ inches, 24⅞ inches and 37⅜ inches, with a stroke of 21 inches. The engines are arranged in a common watertight compartment, with the high pressure cylinders forward and the low pressure cylinders aft. The high and intermediate pressure cylinders are fitted with piston valves, and the low pressure cylinders have a slide valve. These valves are operated by the Stephenson link motion. The engines are very compact, the fore and aft dimensions being reduced to a minimum, the valves being all placed on the side. The distance between centers of the high and low pressure cylinders is only 5 feet 8 inches, and the total height of the engine above the center of the shaft is only 8 feet 6 inches. The over-all length of the engine, including thrust bearing, is 11 feet 6 inches, the over-all width being 6 feet. Each engine is designed to indicate 2100 I. H. P. at about 320 revolutions per minute, which is equivalent to a piston speed of 1120 feet per minute. Each engine is fitted with its own independent condenser, made entirely of sheet brass, of the usual torpedo-boat type; but in the vessels of the Dahlgren class great care has been taken with the arrangement of the scoops or inlet and outlet to the condensers. No circulating pump is necessary for ordinary running, as the speed of the boat forces the sea water through the condenser tubes. A small circulating pump is fitted, however, for use in dock trials, etc. The cooling surfaces of each condenser is 1200 square feet, the shell of the condenser being 7 feet long, of curved form, and 3 feet 6 inches diameter. The tubes are of Muntz metal, tinned, 5-8 inch diameter outside, and they are expanded at the ends into bronzed tube sheets 1 inch thick. The tubes are slightly curved to allow for expansion. Each engine has a single acting air pump, 13 1-4 inches diameter cylinder by 4 1-2 inches stroke, driven from the low pressure crosshead. Also two main feed pumps worked from the intermediate pressure crosshead. The shafts, piston rods, connecting rods, valve rods and working parts generally are of forged nickel steel. The high pressure pistons are made of cast iron, the intermediate pistons of cast steel and the low pressure pistons are of forged steel, the pistons being of equal weight. The bed-plates are made of cast steel, and the framing is of Hyde manganese bronze. Each cylinder is steam jacketed. The cylinders are of close-grained cast iron, the barrels being about 3-4 inch thick. The crank, line, thrust and propeller shafts are of forged nickel steel, with a hole drilled axially through them. The crank-shaft for each engine is in one section, 6 7-8 inches outside diameter. The crank pins are 6 3-8 inches in diameter and 11 3-8 inches long. There is a 3 3-8 inch hole bored axially through each crank-shaft and a 3-inch hole through each crank pin. The thrust shaft is 6 1-4 inches diameter, forged solid with the crank-shaft; each shaft has eleven thrust collars. The propeller and line shafts are each in one section, 6 7-8 inches diameter with a 4 5-8 inch hole bored through.

The propellers are made of Hyde manganese bronze, the starboard wheel being right and the port wheel being left-handed. They are each 3-bladed, with a diameter of 6 feet 6 inches and a pitch of about 12 feet. The blades have an inclined element of 6 inches.

Each vessel is fitted with two brass feed water heaters 14 inches diameter and 5 feet 3 inches long, the heating surface being about 160 square feet. The air compressor, feed water evaporator, distiller for drinking water, and dynamo are located in the engine room.

The machinery of the Dahlgren class consists of two distinct independent units. Each engine has its own boiler and condenser. There are, therefore, two Normand water tube boilers of the "Express" type. The grate surface of each boiler is 59 square feet, and the heating surface is 2776 square feet. This gives a total grate surface of 118 square feet and a total heating surface of 5552 square feet, the ratio of H. S. to G. S. being, therefore, 46 3-4 to 1. As the designed I. H. P. is 4200, the I. H. P. per square foot of grate surface designed is 35.6, an unusually high figure, and the heating surface in square feet per I. H. P. is 2.32, an equally low figure. There are 1550 tubes in each boiler, and these average about 6 feet long, the outside diameter being 13-16 inch. The working steam pressure is 230 pounds. These boilers have an unusually long grate—9 feet 6 inches. The boilers were made as large as possible—indeed, up to the limit in size—so as to obtain the necessary power with but two units, and thus save space and weight with a corresponding increase in efficiency. A large blower, driven direct by a single cylinder engine, is located in the fire-room. This fan takes air from the large deck cowl overhead and also from the engine-room. Forced draught is fitted in the closed stokehold system, and at full power an air pressure of about 4 inches is expected, the fan making about 750 revolutions per minute. Two auxiliary feed pumps are also located in the fire-room.

The electric plant is very complete for vessels of this type, but no searchlights are fitted. The dynamo is a 1½-kilowatt Riker machine, direct coupled to a Sturtevant engine. The drainage system in these vessels includes seven steam ejectors, with a capacity of 100 tons each per hour, situated in the different compartments amidships, and two ejectors with a capacity of 20 tons each per hour in the two end compartments.

The designed weight of the completed hull of the Dahlgren class was 44.55 tons, and the designed weight of the machinery with water was 78.20 tons. The trial load specified was 20.29 tons, and this weight included 7.06 tons of equipment and 9 tons of coal, the remainder being ordnance weight.

These vessels have been designed to have a radius of action of about 1500 nautical miles at a speed of 14 knots. They have, as before mentioned, a total bunker capacity of 32 tons, and they will probably burn about 630 pounds of coal per hour at this cruising speed. The Dahlgren and the T. A. M. Craven are of about the same size as the U. S. torpedo-boats Foote, Rodgers and Winslow, designed four years ago by the Navy Department. It will be interesting to note, however, that whereas the vessels of the Foote class have machinery of about 2000 I. H. P., the vessels of the Dahlgren class are fitted with machinery capable of indicating at least 4200 I. H. P. on the same displacement—a truly remarkable difference. This great difference in power accounts for the speed raising from 24½ knots in vessels of the Foote class to 30½ knots in vessels of the Dahlgren class, a difference of six knots. As before stated, the Bath Iron Works have guaranteed a speed of 30½ knots on these vessels, this speed being the highest ever guaranteed on any vessel of the size carrying the usual torpedo-boat trial load. It will be interesting to note also that British 30-knot boats have a displacement of 275 to 325 tons, and all the American 30-knot boats, with the exception of the Dahlgren and her sister, have displacements varying from 250 to 450 tons. The Dahlgren and T. A. M. Craven will be given their official speed tests during the fall, and the builders are confident that these vessels will soon be recognized as the fastest vessels of their size and type afloat.—*Marine Engineering.*

THE DUM-DUM BULLET.

The report by medical and military officers on the wounds of the Dum-Dum bullet has been issued. In the *précis* of the reports on the nature of the wounds inflicted by the .303-inch service bullet during the operation of the Chitral relief force the following conclusions are arrived at: 1. The entrance and exit wounds are very similar, the latter being somewhat smaller than the former. 2. The bullet drills through a bone and does not fracture it. 3. At close quarters, although important structures may be injured, the injury is insufficient to immediately cause shock or death. 4. Hæmorrhage is comparatively slow, owing to the smallness of the wound. The medical officers agree that the Dum-Dum bullet is not an explosive projectile, and they quote evidence to that effect. In forwarding the reports received from the medical officers serving with the Chitral relief force in 1895, Major-General Morton, Adjutant-General in India, declares his opinion that the nature of the wounds inflicted by the .303-inch bullet and the absence of shock do not justify the expectation that the present service bullet used with the Lee-Metford rifle would stop a cavalry charge, or a charge of fanatics, such as the British Army is liable to meet on the northwest frontier of India or in the Soudan.—*Engineering.*

THE ENGLISH MARK IV CORDITE AMMUNITION.

The Peace Congress considered the "Dum-Dum" bullet at considerable length, and England strongly opposed any restrictions against its use among savage tribes. There are certain cases, however, where its use really seems to be advisable. When dealing with fanatics like the Soudanese, a war of extermination must be carried on, and the Dum-Dum bullet seems to be the most effective remedy for placing the enemy hors-de-combat, and the bullets are also used in the prison of one of our Western States. Nowadays all the chief powers have small-bore rifles and are liable to become involved in warfare with more or less savage races, as when their colonial possessions are menaced, so that many of them doubtless desire to use the most effective bullet possible. The English "Mark IV" cartridge contains a cordite charge as sent to the Cape. The bullet has a hollow in the head, and the nickel sheath ends on a lip at the entrance. A small disk of nickel is forced down to the bottom of the recess. This bullet when it comes in contact with any moist substance, such as the living body, spreads out into a sort of rounded knob, but the nickel cover prevents any flying or separation of the fragments. If the bullet strikes any hard substance, such as wood, it passes through it, cutting a clean hole. The cordite charge takes the place of the powder in the ordinary cartridge and it is set off by means of a cap and anvil. The Peace Congress prohibited the use of bullets covered with a hard outer case unless the case covers the core entirely and is free from incisions. There has been considerable objection to the Dum-Dum bullet because it is said it does not carry straight. It is likely that it is doomed for modern warfare, but it should not be forgotten, in dealing with savage tribes, they are not particular as to what form of bullet or weapon they use. This ammunition has been tested at Bisley, England. Some of the cartridges caused the bore of the gun to become obstructed and momentarily checked the free expansion of the gas by the stripping on the nickel sheath; this was followed by injury to the guns such as the blowing out of breeches, etc. Cordite is a true explosive, and its use in guns of small caliber requires that the cartridges shall be mechanically perfect to avoid obstructions which tend to cause the barrel to be shattered. The ammunition tests at Bisley showed that economy must not be considered where cordite is used.—*Scientific American.*

TEST OF THE NEW NAVAL 4-INCH GUN.

A new type of 4-inch, 50-caliber gun for the navy has just been tested at the Indian Head Proving Ground, giving excellent results. With a charge of 17 pounds of perforated grain navy smokeless powder, a muzzle velocity of 2991 foot-seconds was obtained, with a muzzle energy of 2049 foot-tons, with a chamber pressure of 16.95 tons per square inch. With a charge of 16¾ pounds a muzzle velocity of 2937 foot-seconds was obtained, with a muzzle energy of 1972 foot-tons.

The gun was designed for 3000 foot-seconds muzzle velocity within the limits of 17 tons pressure per square inch, and there is no doubt but that, with a powder of the proper grain, the requirements will be easily fulfilled. The weight of the new gun is 2.72 tons, while that of the old type 4-inch gun is 1.5 tons. The old type gun, with smokeless powder, has a muzzle velocity of 2200 foot-seconds, and a muzzle energy of 1108 foot-tons. The muzzle energy of the new gun is, therefore, 78 per cent. greater than that of the old.

The old gun has a muzzle energy of 738 foot-tons per ton of gun; the new gun has a muzzle energy of 750 foot-tons per ton of gun. The old gun has 92 foot-tons muzzle energy per inch of shot's circumference, and the new gun has 170 foot-tons muzzle energy per inch of shot's circumference. The old gun has a muzzle energy of 33.5 foot-tons per pound of projectile, and the new gun has a muzzle energy of 62 foot-tons per pound of projectile.

A new type of mount for the heavy 4-inch gun was also tested and worked in a thoroughly satisfactory manner during the firing of the thirty-five rounds to which the gun was subjected.

The new monitors, in addition to their 12-inch turret guns, will each have an auxiliary battery of four of the new 4-inch guns.

The Ordnance Bureau of the navy is much gratified with the performance of the new gun, as the larger calibers of the new high-powered gun now being manufactured for the battleships of the Maine class and the monitors are designed practically on the same lines as the 4-inch gun just tested. The next new gun to be tested will be one of 6-inch caliber, and it will be interesting to note its performance, as a new 6-inch gun manufactured by Vickers, Sons, & Maxim, of England, will soon be fired at Indian Head.—*Scientific American.*

THREE-POUNDER SEMI-AUTOMATIC GUN.

Four semi-automatic guns were secured from the Maxim-Vickers Company during the war. It is a gun which in the rapidity of its fire comes midway between the ordinary rapid-fire type of gun, of which the 6-pounder that did such good work in the late war is the most familiar to the American people, and the fully automatic gun, as represented by the Maxim 1-pounder, one hundred of which have just been finished for our navy at the Washington gun-shops. In the simple rapid-fire gun the three operations of opening the breech, inserting the cartridge and closing the breech are done by hand. In the semi-automatic gun the opening and closing of the breech are done automatically, the only manual operation being the insertion of the cartridge, while in the fully automatic type the opening of the breech, insertion of the cartridge, extraction of the cartridge, and closing of the breech are carried on automatically and continuously by the gun itself as long as there is a feed of cartridges in the belt or hopper.

In the semi-automatic gun the first opening of the breech is done by hand, by pressing down the lever which is attached at the right-hand side of the breech. When the gun is fired a portion of the powder gases enters a small cylinder, and, acting on a piston, serves to throw down the breech-block and eject the empty cartridge case. The act of pushing in a fresh cartridge disengages the breech-block, which is at once closed by a spring. The gain in time occurs through the substitution of automatic for manual closing and opening of the breech. It is not likely that this type of gun will be introduced on our battleships, for it is considered that the increased complication of the breech mechanism and the greater risk of disablement more than offset the greater rapidity of fire. Moreover, the gain in rapidity is not so great as might be supposed, for the speed of fire is determined by the rapidity with which the gun can be sighted, and as the loading in the case of the simple rapid-firer, has to wait on the sighting, it is not clear that any advantage is gained by the semi-automatic principle except in special emergency.

It has been suggested that, in view of the greater carrying power of the 3-pounder, it would be a better weapon to mount in the tops of our warships, and in this connection it is pointed out that very few hits were scored by the 1-pounders in the battle of Santiago. As a matter of fact, however, the 3-pounder, which weighs 1440 pounds complete, and its saddle and stand, is too heavy and too cumbersome a weapon for the tops. It has also been suggested that, on account of its high velocity, rapidity of fire, and carrying power, the 3-pounder should replace the 6-pounders on the superstructure and bridges. This is not desirable, and indeed would be a step backward, for the tendency to-day is to greatly increase the weight of the secondary armament. In the British and Russian Navies the 6-pounder has given place to the 12-pounder 3-inch gun, and it is probable that if a change is made on our ships it will be from 6-pounders to 12-pounders. The 12-pounder is a very formidable weapon at any of the ranges at which a naval fight is likely to take place.—*Scientific American.*

SIR ANDREW NOBLE ON THE RISE AND PROGRESS OF RIFLED NAVAL ARTILLERY.

We only propose here to make a general review of Sir Andrew Noble's paper read before the Naval Architects at Newcastle-on-Tyne, reserving certain features for future notice. It is hardly necessary to observe that the paper is of special importance. Apart from the weight the statements may themselves carry, is to be remembered the fact that Sir Andrew was selected by Lord Armstrong, when the Armstrong gun was first adopted, as the most able professional artillerist that he could meet with, and that from that time Sir Andrew took his place, as we think will be allowed, as the foremost pioneer of artillery in England, Elswick initiating not only almost every advance that was made in artillery in this country, but some of the most important in the artillery world. Of these the one of most practical influence is undoubtedly the introduction of quick-fire ordnance, and so completely was the question grasped, and the lead taken from the beginning, that while the earliest Elswick quick-firing pieces had their sights fixed on the cradles, and were thus unaffected by recoil and available for use during loading, this principle on which the French Chamber some years later insisted as essential to quick laying and firing, was so slowly apprehended that in the Chicago Exhibition in 1893 but few quick-firing pieces had their sights fixed on the non-recoil portion of the mountings. The development of the long "new type" guns in this country, with their slow-burning charges and enormous muzzle velocity and energy, was due mainly to Sir Andrew. The system of mounting the trunnionless guns, and subsequently the small compact carriages with brakes of extraordinary efficacy and power, must be attributed to Rendel and Vavasseur respectively; but all come under the head of Elswick designs, and at Elswick individual assignment is rather discouraged. However, enough has been said to show any readers who may need it the great weight that should be given to the statements in Sir Andrew's paper, and we must proceed to deal with the paper itself.

We may begin with the forward bound that artillery science took in England with the introduction of the Armstrong breech-loading gun, the chief gain being at that time in accuracy, guns not having up to then been made sufficiently strong to bear the strain required to give a long projectile a high velocity, though the short length of piece was responsible for greatly increasing this difficulty. This was the day of wrought iron coil guns, and admirably they answered their purpose until steel was brought to the high standard it subsequently attained. The breech gear caused some trouble in larger calibers in those days, but the 40-pounder was an admirable gun. Iron and steel carriages soon came in, and gradually the investigations made in connection with the Explosives Committee rendered it possible to give higher velocities to elongated shot, and in 1877 the investigations of Noble and Abel enabled 2100 foot-seconds to be reached in 6-inch and 8-inch guns. Besides the gain in energy, which was nearly 75 per cent., the variation in velocity now enabled the laws of perforation to be investigated in a way that had hitherto been impossible. The introduction of quick-firing guns proper had been suggested to Sir Andrew Noble by the success of the machine pieces. The natural complement of these was smokeless powder, and these came in nearly universally together, smoky powder, we may observe, lingering strangely long in the otherwise advanced armaments of the United States, and even exhibiting its power of hindrance in the recent war. Sir Andrew dwells on the sentiment of regret with which he at an early period gave up the black powder, with which he had worked so conspicuously, for smokeless powder, more particularly cordite, which, with absence of smoke, gave 50 per cent. increase of muzzle energy for a given pressure, advantages which it was necessary to secure at the cost of increased erosion and wear of bore produced by smokeless powder, due, in Sir Andrew's opinion, to three causes—heat of combustion, pressure, and motion of products, not to chemical action. This view has been established by many experiments. There is some reason, however, to hope that the temperature of explosion may before long be diminished.

With cordite very high velocities are possible, but for many reasons they do not give energy in the best way. With an aluminium projectile Sir Andrew obtained from a 6-inch gun 100 calibers long a muzzle velocity closely approaching 5000 foot-seconds.

To come to practical results with quick-firing guns. In an early experiment a 5-inch gun got off ten rounds in six minutes sixteen seconds, that is, before the then service gun had fired its second shot.

The improvements in mountings embodied specially the principle of recoil in the line of fire at all angles of elevation. In 1890 the pedestal mounting with cradle was introduced. This is extremely strong, and involving no roller paths, the deck may suffer considerable distortion without interfering with the working of the piece. There is a 3-inch shield balanced and attached by means of flexible straps, so as to save the carriage as far as possible from transmission of shock when the shield is struck. An actual test of the behavior of this mounting for a 4.7-inch gun under the attack of 3 and 6-pounder guns showed its superiority to one with a rigidly-fixed shield, the latter being disabled after one round from each of the above guns, while the former bore four rounds from a 3-pounder, six from a 6-pounder, and two from a 4.7-inch gun before it was disabled; and had the pedestal been made as now, of forged steel, it would not have yielded as it did; even as it was, the damage could have been rectified in a few hours. At Elswick, cast-steel cradles were replaced by those of forged steel in 1894, in consequence of the moulders' strike, and a superior and more trustworthy design has thus come in. The progress in efficiency is seen by a comparison between the 32-pounder of 6.3-inch bore of 1850 and the 6-inch 100-pounder gun of the present day. The former has a muzzle velocity of 1600 foot-seconds, the latter 2570 foot-seconds. The energies are respectively 570 and 4580 foot-tons; but the rapidity of fire and accuracy have been improved in a still more remarkable degree. In the target practice carried on by the navy, each gun's crew has three minutes to do what they can at varying ranges, beginning at 2200 yards, diminishing to 1600, and again increasing to 2200 yards. In H. M. S. Blake the best gun's crew fired eighteen rounds, hitting the target fifteen times, while the total number of rounds fired by her ten guns was 148, the target being hit 110 times. H. M. S. Royal Arthur did nearly as well, the best gun having fired eighteen rounds, and having struck the target fourteen times. After touching on dismounting gear, Sir Andrew's paper then goes on to the arrangements for training and laying guns in swift cruisers, by which one man can train with electric gear through 180 deg. in 30 seconds, and by hand through 60 deg. in 25 seconds. With Mr. Vavasseur, Sir Andrew submitted to the Admiralty a mounting on which a gun could be fired at all elevations up to 35 deg. or 40 deg., which was tested in the Handy with complete success.

A good example of armored gun-house is furnished by that on the Chilian cruiser O'Higgins, which has 8-inch armor in front, and 5-inch on the sides and in rear, the trunk for the supply of ammunition is 5 inches thick. A store of projectiles is carried in the gun-house, and a further supply may be brought up through the trunk which is generally used for the conveyance of cordite charges. In the O'Higgins' gun-house training is effected by electric or hand gear, and in the twin armored gun-houses of several Japanese cruisers the training gear can be worked by hydraulic, electric, or hand power, the projectiles and charges being dealt with as above.

Passing to heavy guns, the 13½-inch 68-ton guns of the Umberto are referred to as an early example of all-round loading, and the provision of a working chamber below the turntable with hoists connecting the position in rear of the gun with the center of the working chamber floor. These features have been brought out in more recent ships.

The original single fixed loading station of the oval barbettes of the Royal Sovereign class were succeeded by a better design, with alternative stations in the Majestic class and the Japanese ships Fuji and Yashima; and had the construction been less far advanced, the last five ships of the Majestic class might have had provision for all-round loading, which first found expression in the English Navy in the Canopus. In future, considerable weight may be saved by increasing the storage of shell below the turntable, and abolishing central shot hoists and shell-rooms at the bottom of the ship. In the Canopus the projectiles are carried to the gun hoists by overhead traveling cranes above the central hoists; in the Albion, by a revolving platform running on rails; and in the Shikishima, by a double overhead rail half moving with the hoist, and half being fixed to the ship; and in the Formidable, by having two shot carriages running on rails carried at the bottom of the trunk of the hoist. A still better provision, devised by Mr. Murray, appears to have solved this problem of supply to the gun in all positions satisfactorily. Sir Andrew, however, expresses a hope that automatic arrangements will not be pushed so far as to degrade the "blue jacket" to a mere machine, and to sacrifice simplicity further than is desirable.

Sir Andrew, in passing to explosives for bursting charges of shells, confines himself to three kinds—gunpowder, gun-cotton and Melinite or Lyddite. Gun-cotton and Lyddite are capable of detonation, and also possess a very much greater potential energy than gunpowder. Distinguishing between the action of shells on unarmored and armored structures, he points out that in the former, that is in the attack of unarmored structures, shells charged with gunpowder do not generally explode until they are some short distance within the side of the vessel, but "with gun-cotton and Lyddite two alternatives have to be considered." "The shell may either be fired with a fuse and detonator, so arranged that the shell will burst immediately on impact, or it may be so arranged as to give rise to a slight delay or hang fire. In the first alternative the shell will burst instantaneously on impact—a result impossible to obtain with gunpowder—and in such cases a hole of very large dimensions, and impossible to plug, will be made in the side of the ship, while innumerable small fragments to which the shell is reduced sweep the deck in the wake of the shell."

"In the second alternative, the shell will probably burst inside, making only a small hole in the side of the vessel, but the full effect of the explosion and the destruction to the crew from the fragments of the shell would undoubtedly be serious, and the case of dispersion of the fragments much larger from the explosion taking place inside the vessel."

"Shell charged with gunpowder against unarmored structures possess, however, one great advantage. The shell will probably burst from 2 feet to 4 feet inside the vessel, and although the dispersion of fragments is not nearly so great as with high explosives, the large fragments into which the shell parts are capable of doing much more serious damage to any portion of the ship's structure with which they may come in contact."

"If fired at armored structures, the results will greatly depend upon the thickness and resistance of the plates, and on the size and energy of the attacking projectile." Generally, it may be stated, that armor is a most effective protection against high explosives, the shell in the large majority of circumstances bursting comparatively harmlessly against the armor. Even if non-fused but with detonators, and possessing "sufficient energy to penetrate the plate, the shell will burst in passing through, but the dispersion of fragments is not very great. If fired without fuse or detonator, wet gun-cotton will not explode, but Melinite or Lyddite probably will, the result to a great extent depending on the thickness of the armor."

Sir Andrew then draws the following conclusions, based on the results of a number of experiments: "(1) To attack unarmored structures, a shell charged with high explosive is a most formidable weapon. The large quantity of explosive that can be carried and the power of immediate detonation permit the vessel to be attacked either by making large holes at or near the water-line, or if the shell should burst on board the effect of the explosion and the destruction to everything in the wake of the shell would be very serious. (2) But with high explosives the shells are reduced to very small fragments, and even very thin steel plates resist penetration. Hence the importance of traverses; and supposing a first-class cruiser to engage two smaller cruisers firing high explosives, one on each broadside, a longitudinal traverse of very moderate thickness would be a protection, the importance of which could hardly be overrated. (3) Having regard to the size of the holes made by high explosives in unarmored structures, I regard it of great importance that, wherever possible, the water-line should be protected from stem to stern with such armor as can be conveniently carried, and that the same protection should be afforded where the guns are carried on the main deck. On the upper deck effective shields, and as thick as can be conveniently carried, should be attached to the mountings. (4) Where an attack is made against thin armor, shell charged with gunpowder are more effective than high explosive shell, as, dependent on circumstances, the former can be got to pass through thin armor and burst inside. I doubt if shell charged with any explosive can be got to pass through thick armor without bursting. (5) There is one serious objection to certain high explosives as bursting charges which is not shared by wet gun-cotton, and that is the liability to detonate if struck by another projectile, or even by a large fragment. Wet gun-cotton is quite safe in this respect, and yet, if fired, for example, by a fulminate, it detonates even more rapidly than in the dry state. This property has led certain governments to adopt it as the high explosives for use on board ship."

In concluding this paper the author defends the Elswick practice, which is "sometimes heard attacked, of mounting as many guns on the broadside as can be conveniently carried. Personally he shared strongly the opinion which a distinguished admiral once made to him, that, supposing a fight between two cruisers equally ably commanded, the victory would remain with the ship that got in first her second broadside, and the victory would be more assured if the broadside were the more powerful. It must also be remembered that with our modern weapons allowance must be made for a gun or two being disabled without altogether crippling the broadside. For these reasons he preferred to carry as many guns as possible, even if the number of rounds carried per gun were reduced."—*The Engineer.*

NICKEL STEEL IN BOILER CONSTRUCTION.

The practical experiments which have been made in the use of nickel steel for boilers have so far given excellent results. Not only is there a lightening of weights due to the superior tensile strength of the alloy, but, what is more important, it has shown both under the test of actual service and in laboratory experiments that it is far more durable than the mild steel ordinarily employed. The saving of weight by the use of the stronger material is not, of course, of so much moment ashore as afloat; but the increased durability which may be given to boilers by using steel for those parts, such as the tubes, which are subject to the most destructive influences, is a question of the very first importance to steam users. Whether the longer life of a boiler built partially or altogether of nickel steel more than offsets its greater first cost may be open to question, but present indications are that it does.

Among the most valuable data on the subject are those afforded by tests which have recently been carried out by Mr. A. F. Yarrow, whose experiments on the question of circulation in water-tube boilers, made a few years ago, attracted much favorable comment and threw upon the subject some greatly needed light. Mr. Yarrow states that the deterioration of boiler tubes is due chiefly to three causes: First, the action of acids in water due to grease; second, the oxidation of the overheated tubes on the outer surface through contact with the hot gases; third, the action of the steam, which if it become superheated decomposes and causes deterioration on the inside of the tubes. Mr. Yarrow made use of lengths of nickel steel and mild steel to ascertain the comparative resisting power of the two materials to the wasting influences above mentioned. This was done in three ways: First, samples were exposed to the action of a dilute solution of hydrochloric acid for certain periods and their weights before and after immersion were compared; then two tubes, one of mild steel and the other of nickel steel, were heated side by side in the same furnace, and the loss due to oxidation through overheating both on the inner and outer surfaces was carefully observed; and lastly, the tubes were heated externally and a jet of highly superheated steam was allowed to act on the inside.

The results in each of the three methods of testing showed the nickel steel to be far superior to the mild steel. In the first test, made on two specimens of the same weight, the loss after 533 hours immersion was in the case of the mild steel 53.19 per cent., while the nickel steel tube had lost only 3.72 per cent.

In the second lot of tests, the amount of oxidation due to the action of fire only was 2.9 times as great in the mild steel as in the nickel steel tubes.

In the third series, with fire outside and superheated steam inside, the nickel steel again demonstrated its wonderful powers of resistance. Each tube weighed originally 612 grammes, and after the test had been running for ten hours, the mild steel tube had burnt entirely through. At this point the nickel steel tube had lost 12.7 grammes as against 85.2 grammes lost by the mild steel. A second mild steel tube was put in, the nickel steel one being retained. After eight hours the second mild steel tube gave out. A third tube was tried and it had been running three hours before the original nickel steel tube gave out, after enduring the test continuously for twenty-one hours. The average life of the first two mild steel tubes was only nine hours. From the last series of tests Mr. Yarrow concludes that deterioration from this cause alone would make it necessary to retube a boiler carrying mild steel tubes 2⅓ times as often as it would one provided with nickel steel tubes.

Another important feature brought out in these investigations related to the permanent increase or decrease in length of boiler plates and tubes due to their heating and cooling. The frequent and sudden variations in temperature due to varying rates of combustion, to opening and closing fire-doors, etc., it is well known, produce permanent changes of length in boiler material. In the present tests exact measurements were taken in order to secure accurate data on a question which so materially affects boiler design. It was found that in a mild steel tube 3½ feet in length, which was heated twenty-one times to a dull red for successive periods of two hours length each, superheated steam at a pressure of 60 pounds being passed through the tube, the permanent reduction of length at the close of the tests was seven-eighths of an inch. Now in the case of a nickel steel tube of similar dimensions exposed to like conditions there was an increase of length of seven thirty-seconds of an inch instead of a contraction. The important bearing of this fact on boiler construction where nickel steel and mild steel are to be placed in juxtaposition is very evident.

Taken altogether, the results of these experiments form a valuable addition to the ascertained data on this subject, and they certainly point to nickel steel as the very material for boiler construction, judged on the score of durability; for Mr. Yarrow estimates that under working conditions boiler tubes containing 20 to 25 per cent. of nickel will withstand corrosion for a far longer period than tubes of mild steel, while their resistance to destruction by the action of heated gases or steam is estimated at about twice as great. Of course it must be borne in mind that the greater cost of the alloy more than offsets its longer life, and for this reason mild steel will probably continue to be used for the ordinary stationary boiler; but for special work, where it is desirable to save weight and avoid frequent repairs, it is certainly the ideal material.—*Scientific American.*

There are few subjects which come before the House of Commons which seem to have a greater attraction for its members than the water-tube boiler, hence when the naval estimates came up for discussion on Friday it was not surprising that the vote of £6,601,000 for shipbuilding, repairs, &c., should form an opportunity on which a number of members could air their knowledge of steam engineering. Mr. W. Allan, who moved the reduction of the vote by £1000, in order to call attention to the failure of the Belleville boilers fitted into some of her Majesty's ships, said the events which had occurred in the fleet during the past twelve months showed that there was something wrong in the mechanical arrangements of our splendid vessels. All the vessels that had recently been fitted with water-tube boilers would unquestionably come home practically as wrecks. He appealed to the First Lord of the Admiralty to appoint an independent committee of experts to investigate the whole question of the condition of our ships. Mr. Goschen, in defending the water-tube type of boiler, said the Powerful had been two years in commission, and they never heard of any defects or difficulties in regard to her boilers, although the runs she had made were superior in speed to anything which had been accomplished by cruisers with cylindrical boilers. In one run she had an average speed of 20 knots an hour for 480 knots. The Admiralty had put the ships with water-tube boilers to much severer trials than any ships had been previously put to. The Terrible had already steamed 20,000 miles, and she performed two sixty-hour trials with perfect success. There had been some leakage not connected with boilers at all, and frequently with cylindrical boilers they had exactly the same experience at the beginning of the ship's commission. But in what had taken place there was nothing to alarm the country. Out of 7600 tubes in the Terrible, only 250 fresh tubes had been required ; and out of 6700 in the Powerful, only the same number of fresh tubes were necessary.—*Engineering.*

BOOK NOTICES.

REMINISCENCES OF THE SANTIAGO CAMPAIGN. By Captain John Bigelow, Jr. Published by Harper Bros.

This book possesses especial interest as having been compiled from a series of letters written home by a regular army officer giving his ideas and impressions from day to day. So many of the accounts of the campaign, having been written from impressions remaining after the completion of the campaign, strive to show reason and give cause for many of the different movements, and make a complete story, that a genuine ignorance of the "why and wherefore" gives a special interest to this personal narrative. His simple and straightforward story of his ignorance of what was coming next, and the suddenness with which he found himself in the fight throw a strong side-light on this interesting campaign.

THE HYGIENE OF THE SOLDIER IN THE TROPICS. By Burat and Legrand. Translated by Capt. G. W. Read, U. S. A. Published by the Hudson-Kimberly Co.

This book gives some interesting comparisons of the losses on the different expeditions sent by European powers to the tropics. It endeavors to point out the causes for these marked variations in the death-rates of different expeditions. It emphasizes the necessity for carefully prepared means of transportation which will allow the soldier to come upon the scene of action in a comparatively vigorous condition. It particularly points out the error in the Madagascar campaign with its prolonged war and immense loss as compared with the Ashantee expedition of the British, finished in two months with practically no loss.

An interesting chapter is devoted to the proper clothing and equipment of a soldier for the tropics as well as the proper food supply. The book will be of particular interest to officers concerned in the fitting out of expeditions to the Philippines as showing present practice abroad from which many useful hints may be obtained.

THE UNITED STATES ARMY AND NAVY, FROM THE REVOLUTION TO THE CLOSE OF THE SPANISH-AMERICAN WAR. Published by The Werner Company.

The narrative which records the annals, together with all the details of administration and the organization, of the army is furnished by Lieut.-Col. A. L. Wagner, while that which recites the history of the navy, and supplies a history of its organization, administration and duties, is written by Commander J. D. J. Kelly, U. S. N. While they cover, in brief, the whole historical ground from the beginning of the Revolution and deal interestingly with the manner in which the Services are commanded and equipped, considerable space is devoted to a graphic account of the operations in the Spanish-American War, the duties of the fleet, and the exploits of the battleships in action.

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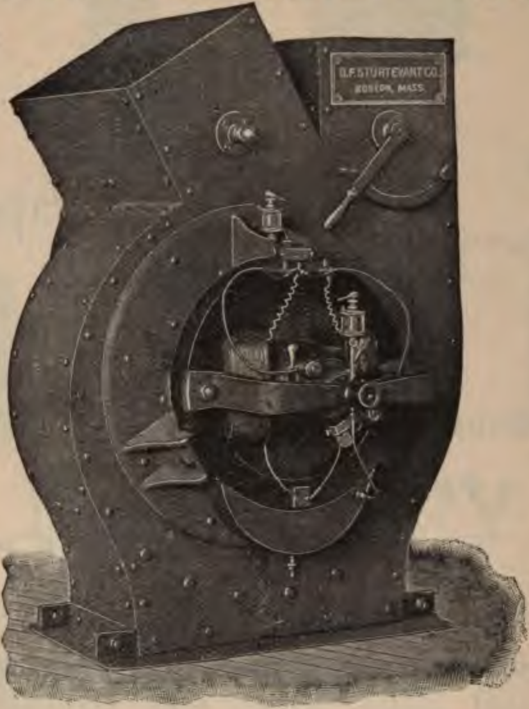

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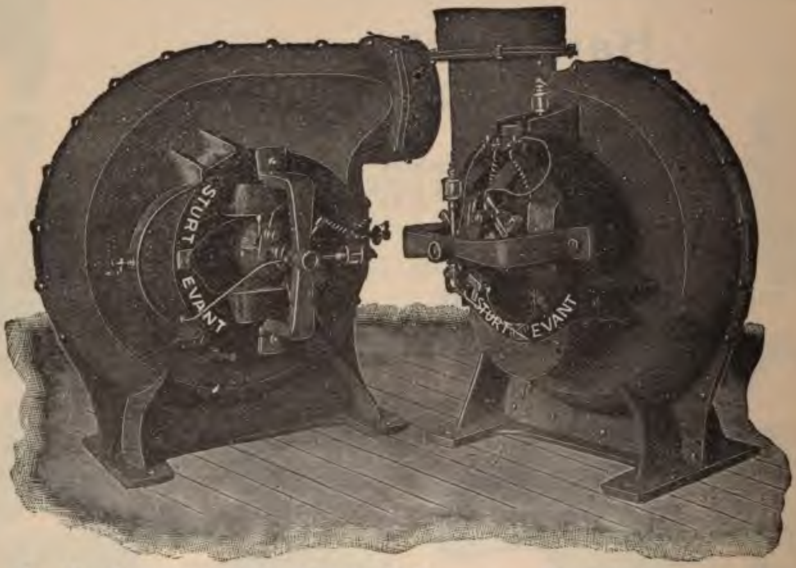

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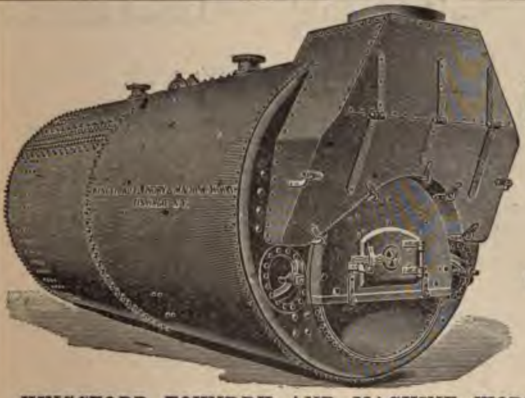

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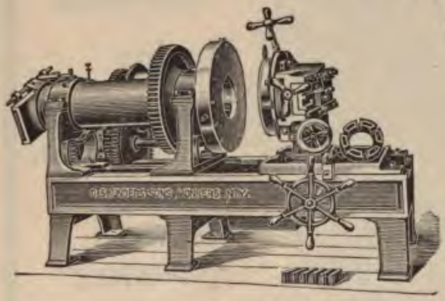
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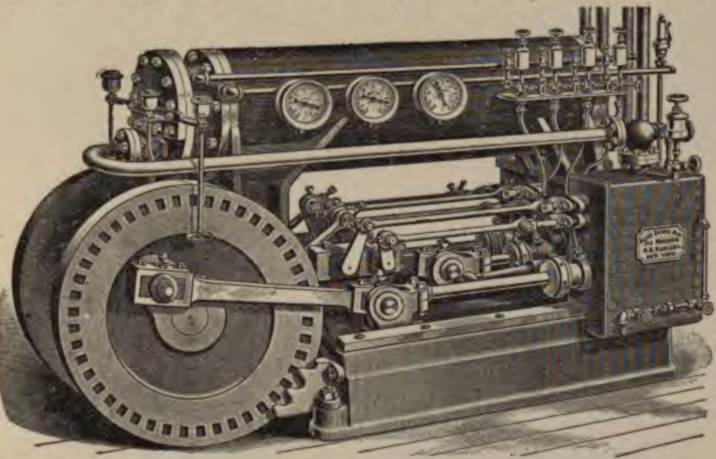

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